# FINAL REPORT GEOTECHNICAL INVESTIGATION WATER LINE REPLACEMENT IN HAMMERLY AREA WBS NO. S-000035-0180-3 HOUSTON, TEXAS

### PREPARED BY ASSOCIATED TESTING LABORATORIES, INC. HOUSTON, TEXAS

ATL REPORT NO. G13-164
July 15, 2014



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July 15, 2014

ATL Job No: G13-164

Van De Wiele & Vogler, Inc. 2925 Briarpark, Suite 275 Houston, Texas 77042-3720

Attention:

Mr. Michael Martin, P.E.

Reference:

Final Geotechnical Investigation Report

Proposed Water Line Replacement in Hammerly Area

WBS No. S-000035-0180-3

Houston, Texas

Dear Mr. Martin:

We have completed the report for the geotechnical investigation for the above-referenced project. Our findings, geotechnical engineering analyses and recommendations are presented in this report.

It has been a pleasure working with you on this project. Should you have any questions concerning this project work, please call us at (713) 748-3717.

Sincerely,

ASSOCIATED TESTING LABORATORIES, INC.

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## GEOTECHNICAL INVESTIGATION WATER LINE REPLACEMENT IN HAMMERLY AREA HOUSTON, TEXAS

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### GEOTECHNICAL INVESTIGATION WATER LINE REPLACEMENT IN HAMMERLY AREA HOUSTON, TEXAS

### **EXECUTIVE SUMMARY**

**Associated Testing Laboratories, Inc.** (ATL) has completed the geotechnical study for the proposed replacement of existing water lines in the Hammerly Area, as shown in Figure 1. The project entails replacing the existing water lines with 6-, 8- and 12-inch diameter water lines, at depths ranging from about 6 to about 12 feet below existing grade (see Figures 2a through 2d).

Trenchless installation technique will mostly be employed. Open cut/trench excavation will be carried out at access pits (auger pits), and possibly in local areas where underground obstructions or site conditions warrant open cut/trenching. The subsurface conditions investigated by 59 soil borings (to 12 to 19 feet below existing grade) along the project alignments, consists predominantly of Lean Clays (CL) and Fat Clays (CH) of soft to hard consistency. A stratum of medium dense Silt ySand (SM) exists in Borings B-1, B-2, and B-18 through B-20, below a depth of about 10 to 12 feet, to the bottom of boring at depths ranging from 1.35 to 18 feet. In Boring B-53, a 2-ft stratum of Silty-Clayey Sand (SM-SC) existing at the surface, and a medium dense Silty Sand (SM) stratum exist between depths of about 12 and 14 feet. Detailed subsurface soils and stratigraphy are shown in the individual boring logs in Appendix 3 and in the Boring Log Profiles in Figures 4a through 4n.

Groundwater was encountered during drilling only in Boring B-18 at a depth of about 14 feet below existing grade, and the borehole caved in at a depth of about 12.5 feet. No free water was encountered in any of the borings at the end of drilling. Borings B-23, B-50 and B-56 were converted into piezometer PZ-1 through PZ-3 after completion of drilling and soil sampling. PZ-1 through PZ-3 were dry 24 hours after installation. Water level was measured in PZ-1 through PZ-3 after 7 days at a depth of about 12.5, 16 and 14.5 feet below existing grade, respectively. Water level

was measured in PZ-1 through PZ-3 after 30 days at a depth of about 9, 16 and 14 feet below existing grade, respectively.

Our main geotechnical findings and recommendations are summarized below:

- 1. No unusual staining or hydrocarbon-like odor was noted in the soil samples recovered from the soil borings drilled in ATL's geotechnical investigation.
- 2. A preliminary fault evaluation based on review of available fault maps and literature review indicated that the documented Long Point Fault is estimated to be about 0.8 miles south-southeast of the project site. Therefore, a Phase I fault evaluation by a Professional Geologist knowledgeable is not recommended.
- 3. Based on proposed flow line depths and the subsurface conditions (see Figures 4a through 4n), the water line installation excavations will be advanced mostly in stiff to very stiff clays. However, there is a possibility that granular soils or soils with limited cohesion may be present at locations away from the locations investigated in this project.
- 4. Based on the proposed invert elevation and the gathered groundwater information, the water line construction excavations approaching or exceed a depth of about 9 feet will likely encounter groundwater. It should be noted that groundwater level will fluctuate with the amount of precipitation prior to and during the construction.
- 5. Geotechnical parameters/information and construction recommendations for the proposed open cut/trenching and trenchless installation of the proposed water lines are presented in Section 5. Construction considerations are provided in Section 6.

### GEOTECHNICAL INVESTIGATION WATER LINE REPLACEMENT IN HAMMERLY AREA HOUSTON, TEXAS

### 1.0 INTRODUCTION

### 1.1 General

The geotechnical investigation for Water Line Replacement in Hammerly Area was authorized via the Professional Services Agreement executed on May 23, 2013, and with the acceptance of the **Associated Testing Laboratories, Inc., (ATL)** Proposal No. CP12-0901R3 dated May 9, 2013. Project details were provided to ATL by Van De Wiele & Vogler, Inc. (VDW&V). This report includes results of the field investigation, laboratory testing, geotechnical engineering analysis and recommendations for the proposed water line replacement for this project.

### 1.2 <u>Location and Description of the Project</u>

The project sites of this project are located in a mixed residential and commercial neighborhood, a Site Vicinity Map showing the project alignments is presented in Figure 1. Photographs of the project sites were taken at the time of our site visit, and some are presented in Appendix 1.

The project entails replacing the existing water lines with approximately 41,090 linear feet of 6-, 8- and 12-inch diameter water lines in the Hammerly Area in the City of Houston, Texas. The project alignments traverse streets in the Key Map 450 N, P, S and T area, and are shown in Figures 2a through 2d.

The approximate invert depths of the proposed water lines at the proposed boring locations, based on information provided by VDW&V, range from about 6 to about 12 feet below existing grade.

Trenchless installation technique will mostly be employed.

### 1.3 Scope of Work

A geotechnical investigation was conducted to determine subsurface soil conditions along the proposed project alignment and to develop geotechnical engineering recommendations for the construction of new underground utilities consisting of water lines. **Associated Testing Laboratories, Inc. (ATL)** has completed a subsurface exploration program for this project consisted of the following scope:

- Augering through existing pavements at borings located within streets with asphaltic concrete (AC) pavements using the drill rig auger.
- Original scope of drilling and sampling entails a total of fifty nine (59) borings (Borings B-1 through B-59), to depths ranging from 12 to 17 feet below existing grade, for a total of 802 lineal feet of drilling, and converting three borings into piezometers (totaling 47 lineal feet) after completion of drilling and sampling. The actual drilling footage, with the extension of select soil borings where sands were encountered at the bottom of boring (per City of Houston Design Guide), entails 59 borings drilled to depths of 12 to 19 feet below existing grade, for a total of 822 lineal feet.
- Conducting laboratory tests on selected soil samples recovered from the soil borings.
- Developing boring logs and boring log profiles to present the general subsurface soil and groundwater conditions.
- Conducting a preliminary fault review of the project area based on review of available fault maps and literature.

Based on results from the field investigation, laboratory testing and gathered geological information, ATL performed geotechnical analyses to develop geotechnical recommendations for the proposed

water lines replacement construction.

### 2.0 SUBSURFACE INVESTIGATION PROGRAM

The field investigation for this project consisted of drilling and sampling a total of fifty nine (59) soil borings and installing three (3) piezometers along the project alignments. The boring/piezometer locations and depths were approved during the proposal phase. The proposed borings and piezometers were selected based on criteria for borings and piezometers specified in City of Houston Department of Public Works and Engineering Design Manual, Chapter 11 "Geotechnical and Environmental Requirements".

The majority of the 59 boring locations were located within existing portland cement concrete pavements (PCC), a few were located within existing asphaltic concrete pavements (AC) and in existing grassy areas. The existing PCC pavements at boring locations were cored through using a pavement coring machine, and the AC pavements were augered through using the drilling rig auger. The information from our boring/piezometer and depths and the coordinates (northing and easting) are presented in the table below.

TABLE A: BORING AND PIEZOMETER INFORMATION

Boring		Piezometer		Location	Northing	Easting
No.	Depth, ft.	No.	Depth, ft.			
B-1	13.5	1		Emnora Ln.	13861609.35	3064059.05
B-2	13.5	1		Emnora Ln.	13861626.73	3064586.67
B-3	13	1		Emnora Ln.	13861632.22	3065116.21
B-4	13	1		Emnora Ln.	13861637.12	3065588.98
B-5	14	1		Emnora Ln.	13861652.08	3066063.86
B-6	13	1		Emnora Ln.	13861688.07	3066954.76
B-7	12	1		Emnora Ln.	13861709.45	3067441.21
B-8	14	1		Moorberry Ln.	13861548.57	3067808.41
B-9	13	-		Moorberry Ln.	13861968.58	3068075.59
B-10	13	1		Vogue Ln.	13861403.15	3066465.06
B-11	13	1		Vogue Ln.	13861427.74	3067085.03

Boring		Piezometer		Location	Northing	Easting	
No.	Depth, ft.	No.	Depth, ft.				
B-12	12			Eaglerock Dr.	13861769.96	3068368.89	
B-13	13			Teague Rd			
B-14	14			Moss Hill Dr.	13861133.19	3066124.91	
B-15	14			Rosefield Dr.	13861106.34	3066841.50	
B-16	14			Moorberry Ln.	13861195.81	3067484.34	
B-17	14			Eaglerock Dr.	13861345.15	3068035.36	
B-18	18			Lexford Ln.	13861462.56	3068486.85	
B-19	13.5			Hammerly Blvd.	13860623.48	3064340.91	
B-20	13.5			Hammerly Blvd.	13860645.28	3064907.36	
B-21	14			Hammerly Blvd.	13860666.01	3065419.57	
B-22	13			Hammerly Blvd.	13860674.16	3065858.06	
B-23	15	PZ-1	15	Hammerly Blvd.	13860566.54	3066377.93	
B-24	12			Moorberry Ln.	13860722.37	3067075.01	
B-25	14			Eaglerock Dr.	13860865.45	3067622.03	
B-26	14			Lexford Ln.	13861081.23	3068178.41	
B-27	12			Longhorn Dr.	13860239.38	3064598.53	
B-28	13			Teague Rd.	13860179.08	3065488.46	
B-29	12			Rosefield Dr.	13860188.06	3066243.52	
B-30	15			Moorberry Ln.	13860091.08	3066531.90	
B-31	15			Hammerly Blvd.	13860250.25	3066953.77	
B-32	12			Eaglerock Dr.	13860430.51	3067247.63	
B-33	14			Lexford Ln.	13860633.54	3067794.09	
B-34	14			Elmgate Dr.	13860665.19	3068191.75	
B-35	14			Vogue Ln.	13860651.69	3068586.00	
B-36	15			Lexford Ln.	13860246.38	3067458.94	
B-37	15			Elmgate Dr.	13860361.95	3067926.46	
B-38	13			Greyburn Ln.	13860085.30	3068058.86	
B-39	14			Parana Dr.	13860083.04	3068506.72	
B-40	14			Springwood Forest St.	13859791.16	3064335.42	
B-41	13			Springwood Forest St.	13859804.64	3065118.21	
B-42	13			Hollow Hook Rd.	13859598.69	3065233.60	
B-43	13			Springwood Forest St.	13859809.36	3065716.21	
B-44	12			Rosefield Rd.	13859788.12	3066220.72	
B-45	13			Eaglerock Dr.	13859891.68	3066783.28	
B-46	15			Lexford Ln.	13859841.10	3067107.58	
B-47	16			Elmgate Dr.	13859945.06	3067568.62	
B-48	12			Moorberry Ln.	13859536.04	3065842.58	
B-49	17			Hammerly Blvd.	13859562.09	3068041.59	

Boring		Piezometer		Location	Northing	Easting
No.	Depth, ft.	No.	Depth, ft.			
B-50	17	PZ-2	17	Truscon Dr.	13859706.70	3068414.91
B-51	18	1		Moorberry Ln.	13859255.63	3064334.54
B-52	13	1		Moorberry Ln.	13859278.53	3064912.71
B-53	19	1		Moorberry Ln.	13859283.23	3065385.84
B-54	14	1		Knoboak Dr.	13859026.50	3064584.62
B-55	14	1		Knoboak Dr.	13859042.41	3065270.37
B-56	15	PZ-3	15	Knoboak Dr.	13859126.21	3065763.90
B-57	14	1		Knoboak Dr.	13859352.08	3066485.08
B-58	13	1		Canoga Ln.	13859102.27	3066906.62
B-59	16			Knoboak Dr.	13859411.38	3067213.24

Boring locations drilled in this geotechnical exploration are shown on Figures 2a through 2d. The boreholes were drilled dry to the bottom of the boring or to a depth where a borehole started caving in, after which rotary wash boring technique was carried out. In cohesive soils, undisturbed soil samples were collected using a conventional 3-inch O.D. Shelby tube in accordance with ASTM D1587. Cohesionless soils were sampled using split spoon sampler in accordance with ASTM D1586. All soil samples were examined, classified and logged in the field. A representative portion of each sample was packed in containers to prevent moisture loss. All soil samples were properly labeled and subsequently transported to the ATL laboratory.

Boring B-23, B-50 and B-56 were converted into piezometer PZ-1 through PZ-3 after the completion of drilling and sampling. The groundwater level information encountered in the boreholes during and at completion of drilling, and the water level in the piezometer after 24 hours, 7 and 30 days are presented in Table 2. The piezometers were pulled and plugged with cement-bentonite grout after the 30-day water level reading. The piezometer installation reports are presented in Appendix 2.

Upon completion of drilling, the borings where no piezometer was to be installed were backfilled using cement-bentonite grout using a tremie. The cored PCC pavements were patched using portland cement concrete, and the augered AC pavements were patched using cold-mixed asphaltic concrete.

All soil samples were classified according to Unified Soil Classification System (ASTM D-2487). The soil and groundwater information found in each boring are shown on the individual boring logs presented in Appendix 3. A Key to Log Terms and Symbols is also presented in Appendix 3.

### 3.0 <u>LABORATORY TESTING PROGRAM</u>

Samples obtained from the field were again examined and classified in our laboratory by the geotechnical technician under the supervision of an engineer. Laboratory testing was performed on selected soil samples collected during the field investigation. The laboratory testing program included Atterberg Limits (ASTM D-4318), Density, Moisture Content (ASTM D-2216), Unconfined Compressive Strength (ASTM D-2166), Unconsolidated Undrained Triaxial (ASTM D-2850) and Percent Finer Than No. 200 Sieve (ASTM D-1140) tests. The results of laboratory tests are presented in the boring logs in Appendix 3 and summarized in Table 3. Overall numbers and types of tests performed for this study for this project are presented below:

TABLE B: SUMMARY OF LABORATORY SOIL TESTS

TYPE OF TEST	NUMBER OF TEST
Dry Density	77
Moisture Content	424
Atterberg Limits	128
Unconsolidated Undrained Triaxial	14
Sieve Analysis thru #200	95
Unconfined Compression	63

### 4.0 SUBSURFACE AND SITE CONDITIONS

### 4.1 Geology of Coastal Plain

The proposed project area is located within the Gulf Coast Structural Province, a huge sedimentary basin containing several thousand feet of sediments. In general, these sediments consist of loose sands, silts and clays which slope gently toward the Gulf of Mexico.

The project site located is underlain by the Lissie Formation of Pleistocene age. The Lissie Formation consists of sand, silt, clay, and minor amount of gravel. Iron oxide and iron-manganese nodules common in zone of weathering and contains locally calcareous material. The surface is fairly flat and featureless except for many shallow depressions and pimple mounds. The surface materials are often weakened by the weathering process.

### 4.2 Geologic Faults

Among the geologic and geomorphological features in this region are sedimentary deposits broken by structure such as normal faults, salt domes, etc. The sedimentary deposits slope gently toward the Gulf of Mexico. They are broken by normal faults, most of which dip toward the Gulf and extend downward many thousands of feet. The earth movements that caused these faults took place within the last 50,000 years. In general, the regional faults in the Houston area trend parallel to the Gulf Coast. Only the local faults over the salt domes show a radial pattern associated with the upthrust of the salt mass. There are numerous faults and fault systems in the Greater Houston and surrounding area. The movements of many of these faults has been affected in recent history by area subsidence. The subsidence is theorized to have been associated with the removal of oil and groundwater. As much as nine (9) feet of subsidence has occurred in the area east of Houston in the last 70 years. Conversion to surface water usage and the limiting of oil production has greatly reduced the subsidence rate in the area east of Houston.

Figures 3a and 3b show the principal active faults in the Houston-Harris County area interpreted from the following sources: Principal Active Faults in Houston Metropolitan Area (Van Siclen, O'Neil, with updates from Norman, 2004); LIDAR Imagery (USGS, HGAC, Khan and Engelkemeir). Based on interpretation of the preceding information, the Long Point Fault is estimated to locate about 0.8 miles south-southeast of the project area. Therefore, ATL does not recommend a Phase I Geological Fault Study. It should be noted that the preceding information is based on known and documented fault information and published fault maps, and the possibility of presence of heretofore-undiscovered faults or unknown faults that do not make surface manifestation exist. If additional information regarding the Long Point Fault and the area geological faulting is desired, a Professional Geologist knowledgeable in geological faulting of Houston-Harris County should be consulted.

### 4.3 <u>Subsurface Soil Stratigraphy and Geotechnical Characterization</u>

**Existing Pavement Material:** Fifty three (53) of the 59 borings were located in existing streets with PCC pavements, one was located in the existing AC pavement, and five were located in the existing grassy areas. The PCC pavements were drilled through using a pavement coring machine, and AC pavements were drilled through using the drilling rig auger. A summary of the existing pavement sections encountered at each boring location is presented in Table 1.

Based on the pavement information gathered from our field investigation, the existing PCC pavements at the boring locations have thicknesses ranging from about 4 to 10 inches, with about 2 to 4 inches of gravel/limestone base at some locations. The existing AC pavement at Boring B-1 consists of about 3 inches of AC surface and underlain by about 7 inches of gravel with sand base. The AC pavement material and thicknesses were estimated from the cuttings from the drill rig auger. The actual pavement material and thicknesses in the field, at or near the boring locations, may differ from those described in the Table 1.

**Potentially Hazardous Materials:** No unusual staining or hydrocarbon-like odor was noted in the soil samples recovered from the soil borings drilled in ATL's geotechnical investigation.

<u>Subsurface Soil Stratigraphy</u>: Based on our soil borings, the subsurface soils along the project alignments consists generally of following:

Along Emnora Lane (Profile 4a): The subsurface soils below the existing AC and PCC pavements consist stiff to hard Lean Clays (CL) to the bottom of Borings B-3 through B-7 at 12 to 14 feet. In Borings B-1 and B-2, the Lean Clay stratum exists to a depth of about 10 feet below existing grade, and is underlain by a stratum of medium dense Silty Sand (SM) to the bottom of borings at 13.5 feet.

Along Moorberry Lane - 1 of 2 (Profile 4b): The subsurface soils below the existing ground surface and PCC pavements consist of stiff to hard Lean Clays (CL) and Fat Clays (CH) to the bottom Borings B-8, B-9, B-16, B-24 and B-30 at depths ranging from 12 to 15 feet below existing grade.

Along Moorberry Lane – 2 of 2 (Profile 4c): The subsurface soils below the existing ground surface and PCC pavements consist predominantly of soft to hard Lean Clays (CL) and Fat Clays (CH), to the bottom of Borings B-44, B-48, and B-51 to B-53, at depths of 12 to 19 feet below the existing grade. In Boring B-53, a stratum of Silty-Clayey Sand (SM-SC) is found in the top 2 feet, and a medium dense Silty Sand (SM) stratum is found between depths of about 12 and 14 feet. Fill consisting of firm to stiff Lean Clays (CL) was found in Boring B-51 to a depth of about 6 feet.

Along Vogue Lane (Profile 4d): The subsurface soils below the existing PCC pavements consist of soft to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Boring B-10, B-11, B-26 and B-35 at depths ranging from 13 to 14 feet below existing grade.

Along Moss Hill Drive (Profile 4e): The subsurface soils below the existing PCC pavements consist of stiff to hard Lean Clays (CL) to the bottom of Borings B-5 and B-14 at 14 feet below existing grade.

Along Hornpipe Lane (Profile 4f): The subsurface soils below the existing PCC pavements consist stiff to hard Lean Clays (CL) and Fat Clays (CH) that exist to a depth of 14 feet in Borings B-14 and B-15 feet below the existing grade.

Along Hammerly Boulevard (Profile 4g): The subsurface soils below the existing PCC pavements consist predominantly of firm to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-21 through B-23, B-31, B-47 and B-49, at depths ranging from 13 to 17 feet below existing grade. In Borings B-19 and B-20, the clay stratum exists to a depth of about 10 and 12 feet below existing grade, respectively, and is underlain by a stratum of medium dense Silty Sand (SM) to the bottom of boring at 13.5 feet.

Along Teague Road (Profile 4h): The subsurface soils below the existing ground surface and PCC pavements consist of stiff to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of borings at a depth of 13 to 14 feet below existing grade.

Along Eaglerock Drive (Profile 4i): The subsurface soils below the existing PCC pavements consist of stiff to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-12, B-17, B25, B-32, B-45 and B-57, at depths ranging from 12 to 14 feet below existing grade.

Along Lexford Lane (Profile 4j): The subsurface soils below the existing PCC pavements consist predominantly of firm to very stiff Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-26, B-33, B-36 and B-46, at depths ranging from 14 to 15 feet below the existing grade. In Boring B-18, the clay stratum is underlain by a stratum of medium dense Silty Sand (SM) below a depth of about 10 feet and exists to the bottom of the boring at 18 feet.

Along Elmgate Drive (Profile 4k): The subsurface soils below the existing PCC pavements in Borings B-34, B-37, B-47 and B-59 consist of stiff to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of borings at depths ranging from 14 to 16 feet below existing grade.

Along Greyburn Lane (Profile 41): The subsurface soils below the existing PCC pavements consist of a stratum of soft to hard Lean Clays (CL) and Fat Clays (CH) to a depth of 14 and 13 feet below existing grade of Boring B-35 and B-38, respectively.

Along Springwood Forest Drive (Profile 4m): The subsurface soils below the existing PCC pavements consist of stiff to hard Lean Clays (CL) to the bottom of Borings B-40 through B-43 at depths of 13 to 14 feet below existing grade.

Along Knoboak Drive (Profile 4n): The subsurface soils below the existing subgrade and the PCC pavements consist of stiff to hard Lean Clays (CL) and Fat Clays (CH) to the bottom of Borings B-54 through B-57, and B-59, at depths ranging from 14 to 16 feet.

The detailed subsurface soils and stratigraphy are shown in the individual boring logs in Appendix 3 and in the Boring Log Profiles in Figures 4a through 4n. "CL", "CH", "SM-SC" and "SM" are classes of soils described in the Unified Soil Classification System.

The lean clays (CL) found in the soil borings have liquid limits ranging between about 23 and 49%, and plasticity indices (PI) ranging between about 8 and 30%. Clean non-expansive sandy lean clay soils (plasticity index between about 10 and 20) can be used as select fill in their present condition. The fat clay (CH) soils found in the soil borings have liquid limits ranging between about 50 and 77%, and plasticity indices ranging between about 31 and 54%. High plasticity fat and lean clays (PI>20) are not suitable for use as select fill in their present condition; however, these soils in their present conditions may be used as random fill. High plasticity clay soils, if clean, can be treated with

appropriate amount of lime and used as select fill; a lime dosage of 7% by weight is recommended for preliminary estimate purposes, but lime vs. pH and/or lime vs. PI series tests should be conducted to determine the optimum lime dosage.

### 4.4 Groundwater

Groundwater was encountered during drilling only in Boring B-18 at a depth of about 14 feet below existing grade; and the borehole caved in at about 12.5 feet. No free water was encountered in any of the borings at the end of drilling. Borings B-23, B-50 and B-56 were converted into piezometer PZ-1 through PZ-3 after completion of drilling and soil sampling. PZ-1 through PZ-3 were dry 24 hours after installation. Water level was measured in PZ-1 through PZ-3 after 7 days at a depth of about 12.5, 16 and 14.5 feet below existing grade, respectively. Water level was measured in PZ-1 through PZ-3 after 30 days at a depth of about 9, 16 and 14 feet below existing grade, respectively.

The groundwater information encountered during and at the end of drilling in the boreholes, and in the piezometer after 24 hours and 7 and 30 days are presented in Table 2. It should be noted that the groundwater conditions will fluctuate according to the amount of precipitation and the environments conditions at the site.

Perched water table may exist in permeable sand/silt lenses/seams/layers within clay stratum that can form pathways for percolated and infiltrated water. The rate of flow of groundwater produced by these layers will depend upon the weather conditions such as locations of size and continuity of the permeable layers/seams/lenses, and the amount of precipitation and ambient temperature etc., at the time of construction.

### 5.0 GEOTECHNICAL ANALYSES AND RECOMMENDATIONS

The proposed water line installation will likely involve augering, one of many trenchless construction technique. Construction of access pits (auger pits) will likely involve open cut/trench excavation; it is also possible that open cut/trenching construction may be carried out in local areas where underground obstructions or site conditions warrant the construction technique. Based on the plan and profile drawings, the water lines are proposed to be installed at depths ranging between about 6 and 12 feet.

### 5.1 OSHA Soil Types

At the federal level, Occupational Safety and Health Act (OSHA) requires protective systems for all trenches exceeding 5 feet in depth. OSHA has developed a soil classification system to be used as a guideline in determining sloping and protective system requirements for trench excavations. This system has set forth a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing amounts of stability.

<u>Stable Rock</u>: Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

<u>Type A</u>: Cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) or greater.

However, no soil is Type A if:

- The soil is fissured; or
- The soil is subject to vibrations from heavy traffic, pile driving, or similar effects; or
- The soil has been previously disturbed; or
- The soil is part of a sloped, layered system where the layers dip into the

- excavation on a slope of four (4) horizontal to one (1) vertical or greater; or
- The material is subject to other factors that would require it to be classified as a less stable material.

### Type B:

- Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf; or
- Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or
- Dry rock that is not stable; or
- Material that is part of a sloped, layered system where the layers dip into the
  excavation on a slope less steep than four horizontal to one vertical (4H:1V),
  but only if the material would otherwise be classified as Type B.

### Type C:

- Cohesive soil with an unconfined compressive strength of 0.5 tsf or less; or
- Granular, including gravel, sand, and loamy sand; or
- Submerged soil or soil from which water is freely seeping; or
- Submerged rock that is not stable; or
- Material is a sloped, layered system where the layers dip into the excavation on a slope of four (4) horizontal to one (1) vertical or steeper.

Based on the soil conditions from the borings and groundwater information from the borings and piezometers, ATL recommends classifying the top 9 feet of the onsite clay soils (CL/CH) that are soft to firm as OSHA Soil Type "C", and those that are stiff to hard as OSHA Soil Type "B" for the determination of allowable maximum slope or selection and design of the protective system. All onsite clay soils below a depth of 9 feet shall be classified as OSHA Soil Type "C". Fill soils, sands (SP/SM/SC), silts (ML), silty clays (CL-ML) and any soils subject to hydraulic pressure or vibrations shall be classified as OSHA Soil Type "C".

### 5.2 Open Cut/Trench Excavation

The proposed water line installation will involve construction using trenchless techniques. However, construction of auger pits for the proposed water line installation will involve open cut/trench excavation, it is also possible that open cut and trenching may be carried out in local areas where underground obstructions or site conditions warrant such a construction technique.

The approximate flow line depths and the subsurface conditions found in the soil borings are shown in the Boring Log Profiles on Figures 4a through 4n. Accordingly, the water line installation excavation will be advanced mostly in stiff to very stiff clays (CL/CH), with locally soft to firm stratum.

The trench excavations can be made using cut slopes stepped back to stable slope, vertical cuts supported with sheet piles or other suitably designed retaining system. The excavation should be performed in accordance with the current OSHA 29 CFR Part 1926 of OSHA (Trench Safety System) and City of Houston Standard Specification, Section 02317 – Excavation and Backfill for Utilities.

Trenches should be provided with a proper trench support system. For the trench supporting system, the lateral pressures exerted on trench walls by stiff clays and cohesionless soils are presented in Figure 5a. Where soft to firm cohesive soils are encountered, the lateral pressure may be computed as given in Figure 5b. Where cohesive soils are underlain by sandy soils, the lateral pressure may be computed as given in Figure 5c. Temporary earth retaining walls are sometimes designed assuming an equivalent fluid pressure, in such cases, a lateral earth pressure equivalent imposed by a 84 PCF and 102 PCF fluid is recommended for clay soils above and below the water table, respectively; in sandy soils, a lateral earth pressure equivalent imposed by a 48 PCF and 85 PCF fluid is recommended for soils above and below the water table, respectively. Timber shoring as outlined in

29 CFR Part 1926 of OSHA recommendation may be used in the construction of trench supporting system. Trench boxes are commonly used for trench safety without shoring or bracing in open-cut excavations with vertical walls. In all cases, excavations should conform to OSHA guidelines.

Vehicular and Other Surcharge Loadings: Under normal loading conditions, a surcharge magnitude of q psf can result in lateral earth pressure of about 0.5q in cohesive soils and about 0.4q in sandy soils. All surcharge loads to a distance of 0.5 times the wall height should be considered. Due to the likely presence of roadways along the proposed pipeline alignment, the effects of vehicular traffic should be considered while designing the lateral supporting systems. The highway loading imposed by a H20 truck on a pipe under various depths of soil cover is presented in Figure 6. Figure 7 presents Boussinesq's equation for computing both horizontal and vertical stresses imposed by a surface surcharge load.

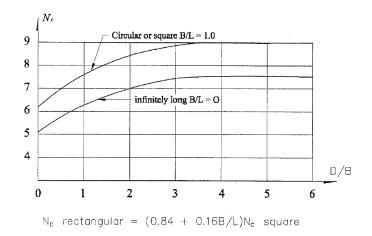
Stockpiling of excavated material should not be allowed near the excavation. Generally, a distance of at least one-half the excavation depth on both sides of the trench should be kept clear of any excavated material and height of stockpile should be limited to no more than 3 feet. If this is not possible due to space limitations then the retaining system design should be designed to take into account the surcharge loads.

In stable cohesive soils and where groundwater is lowered at least 3 feet below the excavation bottom, and if the sheeting terminates at the base of cut, the trench bottom stability can be evaluated in the following manner:

Factor of safety (
$$F_s$$
) =  $\frac{(N_c) C}{(\Upsilon) D + q}$ 

Where,

 $N_c =$  Bearing capacity factor that depends on dimensions of the excavation:



C = Average undrained shear strength of clay in failure zone beneath and surrounding base of cut, psf.

 $\Upsilon'$  = Average effective unit weight of soils above trench bottom, pcf.

q = Surface surcharge, psf.

D = Depth of trench, ft.

L = Length of trench, ft.

B = Width of trench, ft.

If the factor of safety is less than 1.5, sheeting should be extended below the base of the cut to insure stability. The extended sheeting depth should be at least 1.5 times the trench width.

### 5.3 Groundwater Control

Groundwater encountered in the soil borings during and at completion of drilling, as well as the 24-hour and 7 day water level readings in the piezometers were presented in Section 4.4. It should also be noted that fluctuations in groundwater levels may take place as a result of seasonal rainfall variations

The approximate flow line depths and the subsurface conditions as found in the soil borings are shown in the Boring Log Profiles on Figures 4a through 4n. Based on the proposed invert elevation

and the groundwater information gathered during our field investigation, the water line construction excavations below a depth of about 9 feet will likely encounter groundwater. Seepage rate in clay soils will likely be low, but seepage rate in sands will be high. It should be noted that groundwater level will fluctuate with the amount of precipitation and the prevailing environmental conditions prior to and during construction.

Groundwater control for excavation in cohesive soils up to a depth of 15 feet can usually be accomplished by sump and pump arrangements because the seepage is relatively slow. For dewatering below the depth of about fifteen (15) feet multi-staged pumps will be required. When excavations extend into water-bearing sands/silts (not found in soil borings drilled in this investigation, but may be present away from the borings drilled), then dewatering using well points will be necessary. Criteria and requirements of City of Houston Standard Specification, Section 01578 – Control of Ground Water and Surface Water should be followed.

Seams and pockets of sand, silt, ferrous nodules, and calcareous nodules that may exist in cohesive soil layers may form communicative drainage paths for the groundwater, leading to potential water-bearing/perched water condition, and as a result, accelerated the rate of seepage. If such unexpected phenomenon is observed during the trench excavation and construction, appropriate measures, such as proper dewatering and shoring methods, may have to be implemented under supervision of a Professional Civil/Geotechnical Engineer.

### 5.4 <u>Bedding Criteria</u>

Where water line is installed using open cut method, the trench bottom for water line placement should be over-excavated to a minimum of 12 inches. For auger pits the over excavation should be to a minimum of 6 inches. The space should be filled with bank sand to a depth of at least 12-inches above the pipe top and compacted to a minimum of 95 percent of the Standard Proctor (ASTM D 698) maximum dry density at a moisture content between -3 to +5 percent of the optimum moisture

content. The trench bottom should be shaped to receive the water pipe. The bedding details should be in accordance with the latest City of Houston Construction Details. City of Houston Drawing No. 02317-04 should be used for the water main bedding and backfill. The bedding and backfill for auger pit should be in accordance with City of Houston Drawing No. 02447-01.

Soft and/or wet soils, if encountered at trench bottom, should be handled according to requirements specified in City of Houston Standard Specifications Section 02317, Subsection 3.07, A and B.

### 5.5 Trench Backfill

The backfill should conform to standard City of Houston Specification, Section 02317 – Excavation and Backfill for Utilities. The backfill materials should conform to standard City of Houston Specification, Section 02320 – Utility Backfill Materials.

The embedment material between the pipe and the trench (bedding, haunching and initial backfill) may consist of bank run sand placed in maximum six-inches compacted lift thickness and compacted to a minimum of 95 percent of the maximum dry density as determined by Standard Proctor test (ASTM D698) at -3 to +5 percent of the optimum moisture content.

In the trench zone within the pavement area, the backfill may consist of bank run sand or select fill. The bank run sand should be placed in maximum 12 inches loose lift thickness and compacted by vibratory equipment to a minimum of 95 percent of the maximum dry density at moisture content within zero percent to -3 and +5 percent of optimum as determined by ASTM D698. The select fill may be placed in maximum 6-inch compacted lift thickness and compacted to a minimum of 95 percent of the maximum dry density at moisture contents within 0 and +5 percent of optimum as determined according to ASTM D 698. The cut pavement should be replaced to match the existing pavement type and the thickness should be equal or greater then the existing pavement thickness. The finished pavement surface must be even with existing pavement elevation. In the trench zone

outside the pavement area, a random backfill of suitable material (clayey soils) may be used. The random backfill may be placed in maximum 12 inches loose lift thickness for clayey soils and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D 698 at moisture content necessary to achieve the density.

### 5.6 Loads on Buried Conduits

The pipelines placed at depths under the ground will be subject to loads due to backfill (earth loads) and loads due to vehicular traffic (live loads).

<u>Earth Load</u>: The earth loads on a buried pipe can be calculated based on Marston's formulae (Ref: 1 through 3). The Marston's equation for buried conduits are generally given as:

$$W_d = C_d \Upsilon B_d^2$$
 - for rigid pipes

$$W_d = C_d \Upsilon B_d B_c$$
 - for flexible pipes

Where,  $W_d$  = fill load, in pounds per linear foot of pipe

C<sub>d</sub> = Marston's soil coefficient

 $\Upsilon$  = Unit weight of fill material, pcf (use 120 pcf)

 $B_d$  = Width of trench at or slightly below top of pipe, in feet

 $B_c$  = Width of pipe, in feet

The above equation is valid when the conduit is placed in a trench not wider than 2.0 to 3.0 times its outside width. Marston's soil coefficient  $C_d$  can be obtained from Table 4. K is the active earth pressure coefficient and  $\mu$  is the coefficient of sliding friction between the fill material and the sides of the trench. The height of fill and the horizontal width of trench should be considered from the top of the conduit. For the above equation for flexible pipes, an assumption of equal stiffness of soil and pipe has been used for its development and the equation generally gives a minimum load value. Hence, for flexible pipes including ones installed using trenchless construction, the earth loads may

be conservatively calculated using the prism load theory. The prism load (Ref: 1 through 3) determines the weight of the soil column directly above the pipe and neglecting factors such as side wall friction and/or the cohesion of the soils. The prism load (in psf) may be calculated by multiplying the total unit weight of soil above the pipe (say 120 pcf) by the height, H (ft) of the soil fill. The prism load generally gives higher loading on the pipe and simulates the long term load imposed on the pipe.

<u>Vehicular Load</u>: For calculation of live loads, the width of the loaded area should be taken as the outside horizontal width of the pipe. Loading due to H20 vehicle should be considered for vehicular traffic. The estimated highway loading on a buried conduit imposed by a H20 truck, under various soil cover, is presented on Figure 6.

<u>Surcharge Load</u>: The stresses imposed by a surcharge load can be estimated using Boussinesq's Equation presented on Figure 7.

### 5.7 <u>Trenchless Construction</u>

The proposed water lines will be installed using trenchless technique. In general, trenchless installation may involve dry auger or slurry auger method. In the dry auger method, the casing is advanced by jacking while soils are excavated at the advancing end of the casing. In the slurry auger method, a small diameter pilot hole is first drilled between the access shafts, followed by reaming the pilot hole to full diameter by augering with slurry and installing casing or pipe by pull-back or jacking techniques. Requirements of City of Houston Standard Specification, Section 02447 – Augering Pipe and Conduit, should be followed.

The water line will be installed mostly in stiff to very stiff clays, in which case the excavation face are anticipated to be stable. However, there is a possibility that granular soils or soils with limited

cohesion may be present at locations away from the locations investigated in this project. Excavation face in granular soils (sand/silt/gravel), clay soils with slight/low plasticity or containing a significant amount of sands, and other caving soils, if encountered at/near the excavation face, will likely experience some degree of instability if the excavation face is unsupported, especially when these soils are saturated and/or subject to seepage pressure. In such cases, the following mitigating measures can be employed to improve the excavation stability:

- 1) Lower the groundwater table to at least 3 feet below the excavation bottom, and use colloidal drilling fluid (usually bentonite slurry) under controlled pressure to improve stability of the excavation.
- 2) In conditions where mitigation measures employed in Item 1 above cannot adequately provide the excavation stability, a casing can be installed at the same time of the slurry augering to provide stability of the excavation and reduce settlement at the surface.
- 3) In ground conditions where highly unstable soils and/or high inflow rate/pressure exist, microtunneling machine equipped with face shield and pressure-balancing colloidal drilling fluid may be used to maintain the stability of the excavation face.
- 4) Alternatively, open cut with shoring or other methods approved by City of Houston Department of Public Works and Engineering, along with groundwater control, and other stabilizing techniques such as chemical grouting, may be used at locations with difficult subsurface conditions or site constraints.

It is the responsibility of the Contractor to select a trenchless technique for the installation of the proposed water line by taking into account the soil types and stratigraphy and the groundwater conditions as found in the soil borings; the Contractor should have a work crew with experience in working with the selected trenchless construction technique in subsurface conditions similar to those found along the project alignments. If necessary, the Contractor may conduct additional geotechnical investigation to provide more detailed subsurface conditions.

Auger pit construction criteria provided in City of Houston Standard Specification, Section 02447 – Augering Pipe and Conduit, should be followed. Shoring systems for the auger pits may be designed based on the lateral earth pressures and other considerations discussed in Section 5.2.

Groundwater conditions were observed in open boreholes during the field investigation and in piezometers and the information were presented in Section 4.4. Water inflow in cohesive soils may be removed using a sump and pump arrangement. If the water inflow is large or where granular soils are encountered, dewatering using well points may be required to provide a dry working platform and to prevent soil boiling.

### 5.8 Effects of Trenchless Construction on Surrounding Structures

A properly designed and controlled augering/trenchless construction operation can reduce immediate soil movement and subsidence to a tolerable level. Nevertheless, some ground loss should be expected during any augering/trenchless construction operations. With good construction techniques, ground loss can be mitigated to acceptable levels. Augering/trenchless construction below pavement and buried utilities may lead to some future settlement due to loosening of the subgrade or bedding condition. Large ground loss can result from uncontrolled flowing ground. Such conditions may occur if water-bearing sands or silts were encountered (not encountered in our soil borings, but may be present away from the borings drilled) in the excavations along the augering/trenchless construction alignment. Measures to mitigate ground loss and other impacts of trenchless construction were addressed in Section 5.7.

The zone of influence of the augering/tunnel roughly extends to a distance equal to the invert depth on each side of the centerline of the augering/trenchless construction alignment. The amounts of settlement due to augering/trenchless construction are difficult to estimate. We anticipate that if good construction practices and control are exercised, the amount of ground settlements should be small. Establishing monitoring points on existing roadways, buildings and other important structures

along the augering/trenchless construction alignments, and record coordinates and elevations prior to, during and after construction to monitor the amount of settlements or lateral movements due to augering/trenchless construction, and adjust augering/trenchless construction technique accordingly to mitigate the movements as necessary. Existing damages to the surrounding structures should be documented prior to starting of the augering/trenchless construction operations.

### 5.9 Thrust Restraint

Unbalanced thrust forces result from changes in flow directions and/or velocity in a pressurized pipe system (see Figure 8). The unbalanced thrust force and magnitude of thrust block force T is defined as follows:

 $T = 2 \text{ PA Sin } (\theta/2)$ 

Where, P = internal fluid pressure (psi);

A = cross-sectional area of pipe  $(in^2)$ ;

 $\theta$  = deflection angle of bend; and,

T = thrust force (pounds)

Adequate restraint may be achieved by using thrust blocks, restraint joints, tie rods, or a combination of these systems. The unbalanced force acting on a pipe system is transmitted by a thrust block and resisted by the bearing area between the pipe and the foundation soils. The unbalanced force acting on a pipe system with restraint joints are resisted by the frictional forces between the pipe/soil interface across the pipe sections restrained to act integrally.

<u>Thrust Blocks</u>: Thrust blocks are commonly used to increase the bearing area to allow the fittings to resist movement. The procedures for thrust block design are given in detail in AWWA M9 (Ref. 1). The required thrust block bearing area is calculated based on the bearing capacity of the soil:

Required Bearing Area of Thrust Block = T/F

Where, T = thrust force (lb); and,

F = safe bearing value for soil (lb/sq.ft)

A safe bearing value of 1,500 psf can be used for thrust block design bearing on compacted soils. This value includes a factor of safety of 3. The blocks must be placed against undisturbed or compacted soils and the face of the block must be perpendicular to the direction of and centered on the line of action of the thrust. Proper care must be exercised after construction to prevent failure due to any future excavations behind the blocks.

<u>Restrained Joints</u>: Restrained joints are typically used to avoid the uncertainties of thrust blocking like future excavations, etc. A detailed procedure for designing restrained joints including example calculations is outlined in the AWWA design manual M9 (Ref. 1). The following soil parameters are recommended for the design of the restrained joint(s):

Average unit weight of soil,  $\gamma$  = 120 pcf

Cohesion of soils, C = 250/500/1000 psf (for soft/firm/stiff clays)

For coefficient of friction between pipe and granular soils, f, use 0.25 for smooth PVC and steel pipes, and use 0.3 for concrete pipes.

### 5.10 Flexible Pipe Deflection

The deflection of a flexible pipe may be determined using the modified Iowa formula of Watkins and Spangler (Ref. 2) as given below:

$$\Delta x = D_1 [KWr^3 / (EI + 0.061 E' r^3)]$$

Here EI is the pipe wall stiffness (in-lb.), r is the radius (in.) and W is the load per unit of pipe length

(lb/in. in. of pipe). Where prism loads (i.e. weight of soil above the pipe) are used for pipe earth loads, a deflection lag factor,  $D_l$  of 1.0 may be used. Otherwise, deflection lag factor,  $D_l$  of 1.5 should be used. The bedding constant, K, may be taken as 0.1. The following typical soil parameters are recommended:

Soil Type	Soil Consistency	Unit Weight, pcf	Shear Strength (c), psf or SPT Blow Counts, blows/ft	Modulus of Soil Reaction, psi/in
	Soft	120	c ≤ 250	100
Fat Clays	Firm	124	c ≤ 500	300
and	Stiff	128	$c \le 1,000$	600
Lean Clays	Very Stiff	130	$c \le 2,000$	1,000
	Hard	132	c > 2,000	2,000
	Loose	110	$2 \le N_{SPT} \le 7$	300
Granular Soils:	Loose to Medium	113	$8 \le N_{SPT} \le 15$	600
Sands, Silts and	Dense			
Gravel	Medium Dense	115	$16 \le N_{SPT} \le 30$	1,000
	Dense	118	$N_{SPT} > 30$	2,000

<sup>\*</sup> Buoyant soil unit weight is computed by subtracting unit weight of water from the soil unit weight

### 5.11 Buoyant Uplift

Portion of a buried structure located below the water table is subject to an upward hydrostatic pressure, called the *buoyant uplift pressure*. Resistance to buoyant uplift pressure is provided by the following components:

- Weight of the structure (W)
- Weight of the soil above the base extension beyond the wall(Ws)
- Frictional force between the soil and foundation (Fs).

Buoyant Uplift Resistance = W + Ws + Fs

W and Ws are can be readily computed. The computation of the buoyant uplift, and the skin friction resistance are shown in Figure 9. If base extension option is used, we recommend using a buoyant

unit weight of backfill soil above the base extension of 65 pcf when computing Ws.

### 5.12 Street Cut and Repair

Any street cut necessary for this project should be restored to its original condition using material similar in nature and thickness to the existing streets. Recommendations outlined in City of Houston Standard Specification, Section 02951 – Pavement Repair and Resurfacing should be followed. The top 8 inches of the subgrade soils in the pavement repair areas should be stabilized. ATL recommends stabilizing subgrade clay soils with plasticity indices above 15 and above 25 with at least 6 and 7 percent lime, respectively, and stabilizing granular soils and clay soils with plasticity indices of less than 15 with at least 4 percent lime and 8 percent fly ash, on a weight basis; optimum amount of stabilization shall be determined by conducting laboratory testing.

The lime and lime-fly ash stabilization should be carried out in accordance with City of Houston Standard Specifications Section 02336 and 02337, respectively.

### 6.0 CONSTRUCTION CONSIDERATION

The proposed water line installation will involve mostly trenchless construction techniques and some open cut/trenching construction. Accordingly, the water line installation excavations will most likely be advanced in stiff to very stiff clay soils. However, there is a possibility that granular soils or soils with limited cohesion may be present at locations away from the locations investigated in this project. Excavation face in granular soils (sand/silt/gravel), soils with only slight plasticity and other caving soils (if encountered), will likely experience some degree of instability if the excavation face is unsupported, especially when these soils are saturated and/or subject to seepage pressure. In such cases, mitigating measures as discussed in Section 5.7 of this report can be employed to improve the excavation stability.

Based on the proposed invert elevation and the groundwater information gathered during our field investigation, the water line construction excavations below a depth of about 9 feet will likely encounter groundwater. It should be noted that groundwater level will fluctuate with the amount of precipitation and the prevailing environmental conditions prior to and during construction. For water line installation excavation advanced in clay soils, the seepage rates are usually low, and groundwater control can usually be controlled by sumping and pumping. However, for excavations advanced in water-bearing sands/silts stratum (not encountered in our soil borings, but may be present away from our soil borings), where water inflow rate is high, dewatering using well points will be required to provide a dry working platform and to prevent soil boiling.

It is the responsibility of the Contractor to select a trenchless technique for the installation of the proposed water line by taking into account the soil types and stratigraphy and the groundwater conditions as found in the soil borings; the Contractor should have a work crew experienced at working with the selected trenchless construction technique in subsurface conditions similar to those found in along the project alignments. If necessary, the Contractor may conduct additional geotechnical investigation to provide more detailed subsurface conditions.

### 6.1 Quality Control

Associated Testing Laboratories, Inc. (ATL) recommends implementation of a comprehensive quality control program under the supervision of a Professional Engineer due to the fact that a considerable amount of excavation and back filling may be required in the proposed project area. Structural integrity and stability is particularly dependent on quality foundation installation, bedding and subgrade preparations. An independent testing laboratory should be assigned to test and inspect construction materials during the construction phase.

To ensure that excavation will remain stable, to provide sufficient headroom for working, to provide worker's safety and to protect adjacent structures, the excavations will have to be provided with

sufficient side slopes or shored in accordance with OSHA "Trench Safety Systems" (29 CFR Part 1926), as published in the Federal Register, Vol. 52, No.72, Section 1926-650 through 1926-653. Excavation of the trenches and access pits should be carried out under the supervision of an experienced construction supervisor and necessary shoring and/or bracing of the trenches should be properly installed. In temporary braced or shored excavations and in access pits where the sheeting terminates at the base of the trench, lateral earth pressure, surcharge, and seepage pressure caused by a differential hydrostatic head moving upward to the bottom of the trench can cause trench bottom instability. Therefore, it is recommended that, if the bottom stability evaluation yields a factor of safety less than 1.5, the sheeting should be extended below the base of cut. Before filling operations take place, representative samples of the proposed fill material should be tested by an independent laboratory to determine the compaction and classification characteristics.

### 6.2 Monitoring

Despite the thoroughness of this geotechnical exploration, there is always the possibility that actual subsurface conditions may differ from the predicted conditions because conditions between soil borings can be different from those at specific boring locations.

Any excessive ground movements like settlement and lateral movement should be monitored and controlled. This can be done by performing a preconstruction survey including photography and documentation of existing conditions like elevations, cracks, etc., and by installing ground movement monitoring devices such as inclinometers, crack monitors, and establishing elevation monitor stations along the waterline alignment to monitor the ground movement after commencement of the excavation.

Associated Testing Laboratory, Inc. (ATL) recommends a regular inspection and overall project monitoring by a geotechnical engineer during the construction phase. The purpose of inspection is to provide sound engineering and judgement alternatives during construction, if unanticipated

conditions occur.

# 7.0 <u>LIMITATIONS</u>

The information, findings and recommendations contained in this report are based on data obtained from test borings at the locations shown in Figures 2a through 2d, a reasonable volume of laboratory tests, and professional interpretation and evaluation of the field and laboratory data, and consideration of the project information furnished. Should it become apparent during construction that soil conditions differ significantly from those discussed in this report, this office should be notified immediately so that further evaluation and any necessary adjustments can be made.

# 8.0 REFERENCES

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- 13. CFR PART 1926.

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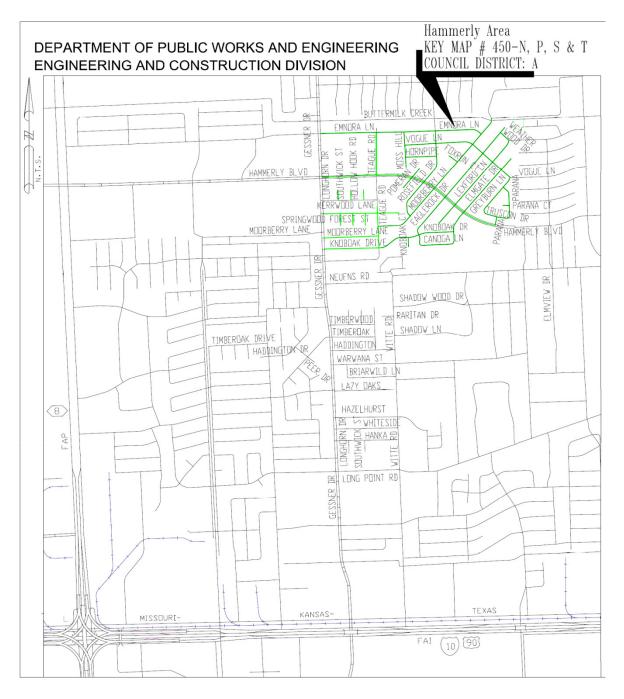
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FIGURE 7 BOUSSINESQ'S EQUATION FOR POINT LOAD SURCHARGE

FIGURE 8 THRUST FORCE AT A PIPE BEND

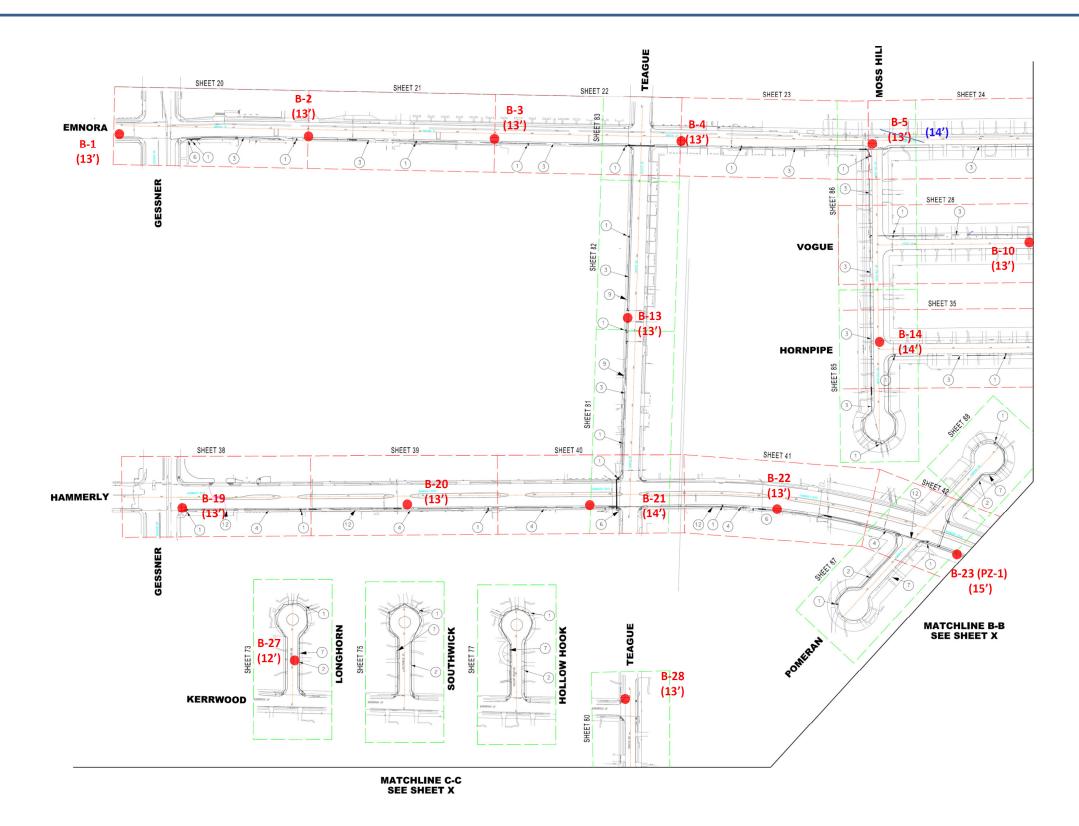
FIGURE 9 BUOYANT UPLIFT RESISTANCE OF A BURIED STRUCTURE

# WATER LINE REPLACEMENT IN HAMMERLY AREA - WBS NO. S-000035-0180-3



WAILK LINE REPLACEIVENT IN HAIVIIVIEREFAREA	PROJECT NO. : G13-164	FIGURE 1
WATER LINE REPLACEMENT IN HAMMERLY AREA	WBS NO. S-000035-0180-3	
SITE VICINITY MAP	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	







## LEGEND

- 1 PROP FH 2) PROP 6"WATER
- 3 PROP 8"WATER
- 5)1-PROP TS&V w/BOX
- 6 1-8"WET CONNECTION
- ABANDON EXIST. 2" WATER LINE & TRANSFER SERVICE TO PROP. 6" WATER LINE 8 ABANDON EXIST. 2" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE
- ABANDON EXIST. 6" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE & ABANDON EXIST. 8" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE
- 11 ABANDON EXIST. 8" WATER LINE & TRANSFER SERVICE TO PROP. 16" WATER LINE
- (2) ABANDON EXIST. 16" WATER LINE & TRANSFER SERVICE TO PROP. 16" WATER LINE (13) EXIST. FIRE HYDRANT TO REMAIN IN SERVICE

LOCATION OF BORINGS

WATER LINE REPLACEMENT IN HAMMERLY AREA

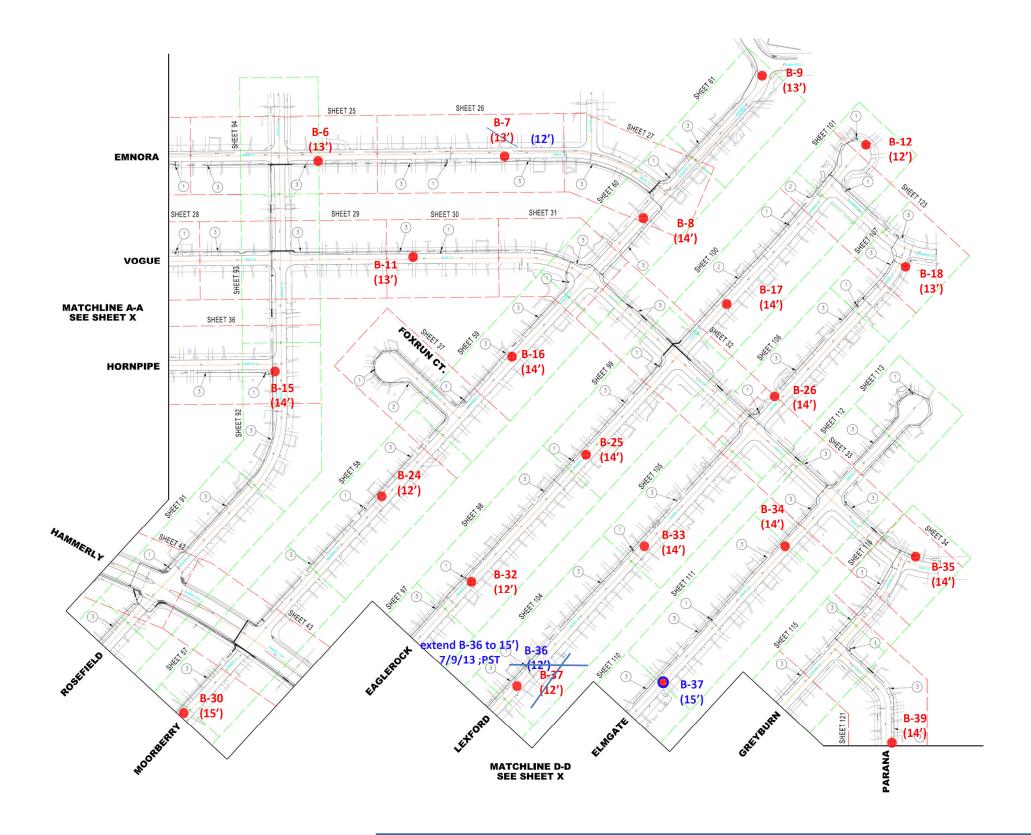
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WBS No. S-00035-0180-3

PROJECT NO. : G13-164

FIGURE 2a







- 2 PROP 6"WATER
- 3 PROP 8"WATER
- 4) PROP 16"WATER
- 5) 1-PROP TS&V w/BOX
- 6) 1-8 "WET CONNECTION
- 7 ABANDON EXIST. 2" WATER LINE & WATER LINE TRANSFER SERVICE TO PROP. 6" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE
- ABANDON EXIST. 6" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER L
- 11 ABANDON EXIST. 8" WATER LINE & TRANSFER SERVICE TO PROP. 16" WATER LINE 12 ABANDON EXIST. 16" WATER LINE & TRANSFER SERVICE TO PROP. 16" WATER LINE
- (13) EXIST. FIRE HYDRANT TO REMAIN IN SERVICE

# LOCATION OF BORINGS

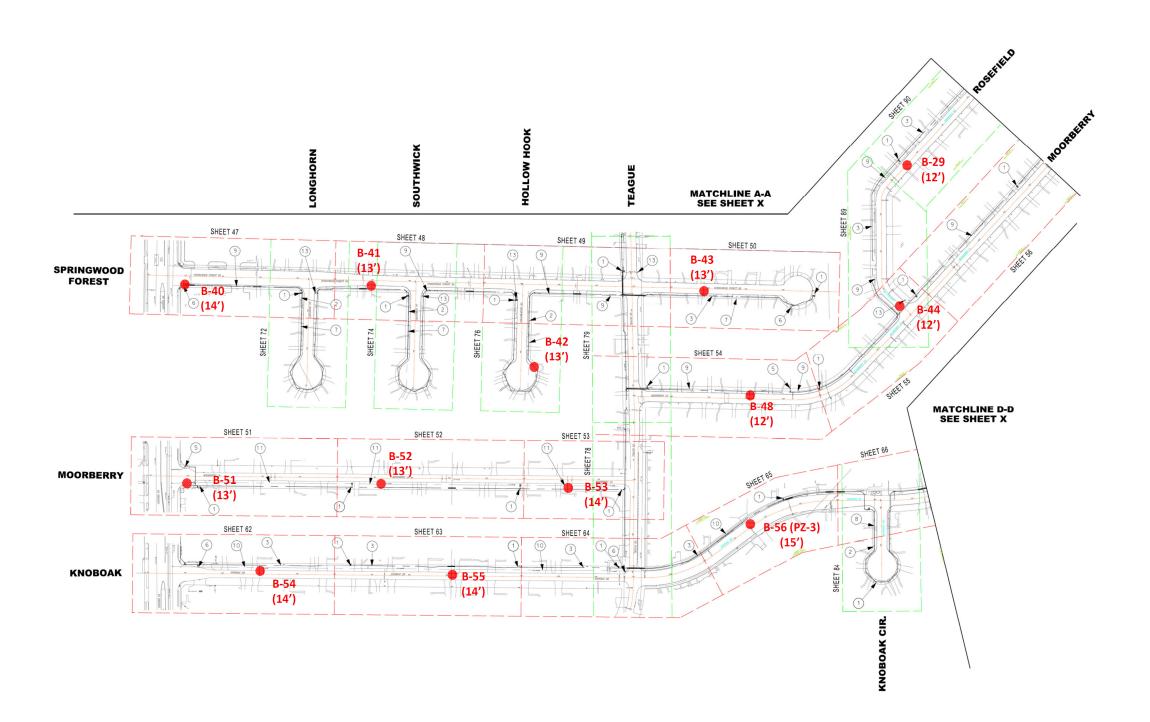
WATER LINE REPLACEMENT IN HAMMERLY AREA

ASSOICATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748

WBS No. S-00035-0180-3

PROJECT NO. : G13-164 FIGURE 2b







# LEGEND

- 1 PROP FH
- 2 PROP 6"WATER
- 3 PROP 8"WATER
- 4 PROP 12"WATE
- (5) 1-PROP TS&V W/BOX
- 6) 1-8"WET CONNECTION
- TRANSFER SERVICE TO PROP. 6" WATER LINE
- 8 ABANDON EXIST. 2" WATER LINE & TRANSFER SERVICE TO PROP. 6" WATER LINE
- 9 ABANDON EXIST. 6" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE
- TRANSFER SERVICE TO PROP. 8" WATER LINE
- 11 ABANDON EXIST. 4" WATER LINE & TRANSFER SERVICE TO PROP. 8" WATER LINE
- 12 ABANDON EXIST. 12" WATER LINE & TRANSFER SERVICE TO PROP. 12" WATER LINE 13 EXIST. FIRE HYDRANT TO REMAIN IN SERVICE

# LOCATION OF BORINGS

WATER LINE REPLACEMENT IN HAMMERLY AREA

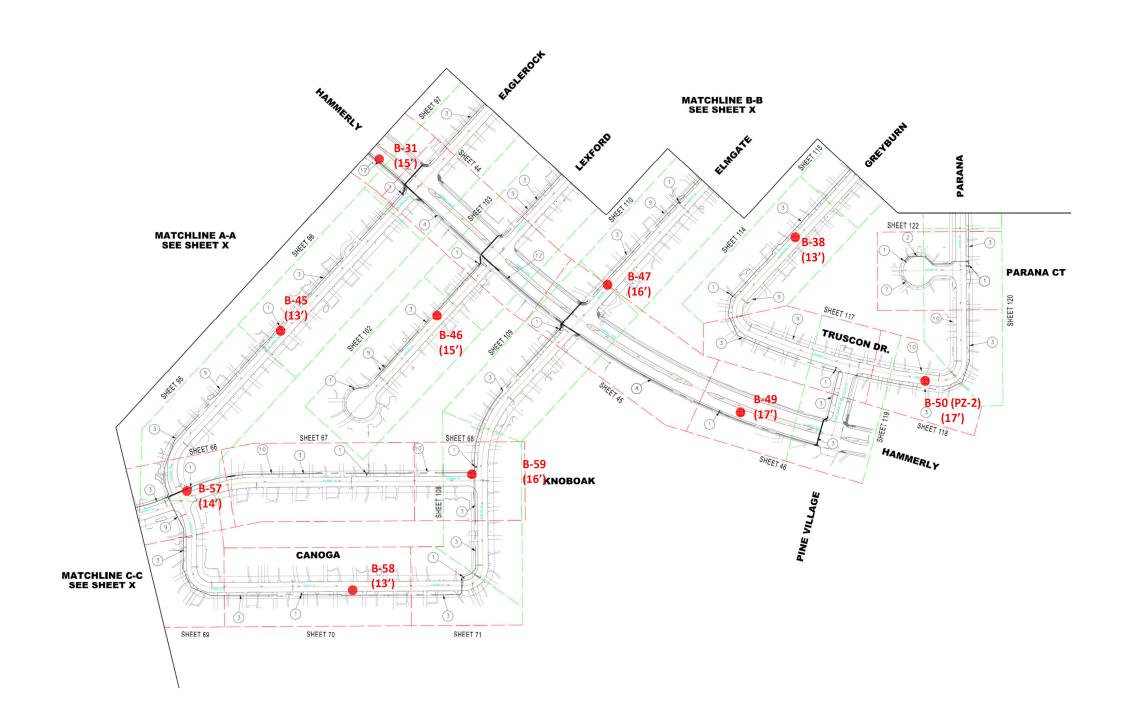
ASSOICATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748

WBS No. S-00035-0180-3

PROJECT NO. : G13-164

FIGURE 2c







- 2) PROP 6"WATER 3) PROP 8"WATER

- 6) 1-8"WET CONNECTION

- 1) ABANDON EXIST. 8" WATER LINE & TRANSFER SERVICE TO PROP. 16" WATER LINE
- 12 ABANDON EXIST. 12" WATER LINE & TRANSFER SERVICE TO PROP. 12" WATER LINE
- (13) EXIST. FIRE HYDRANT TO REMAIN IN SERVICE

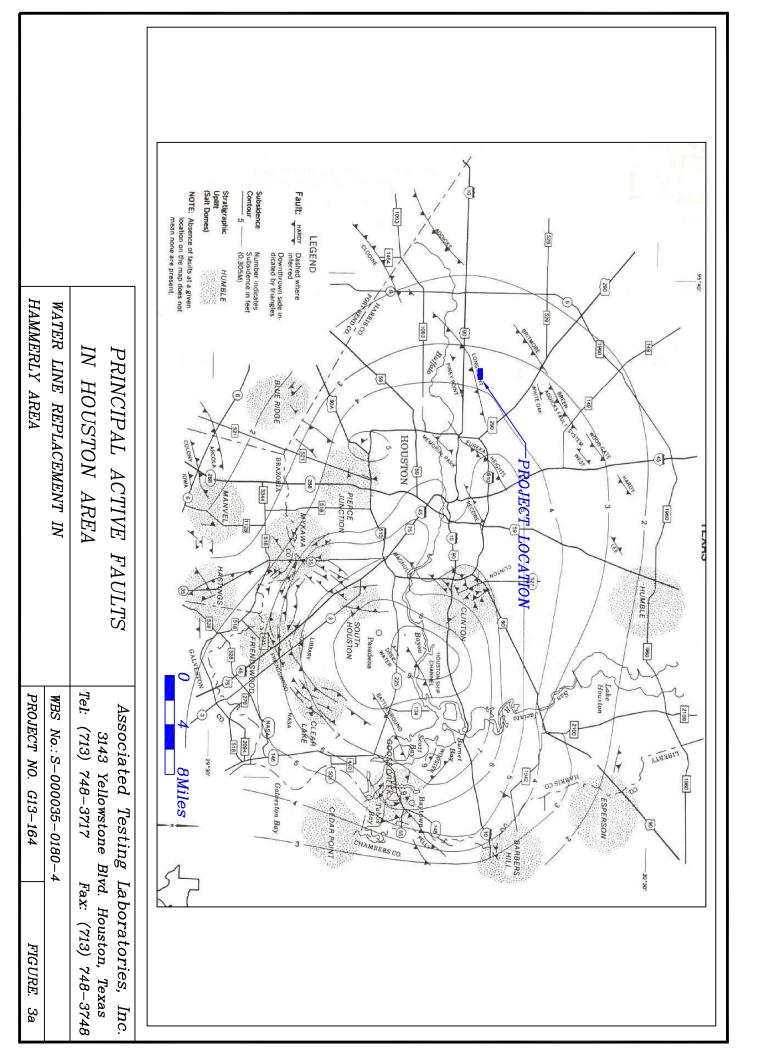
LOCATION OF BORINGS

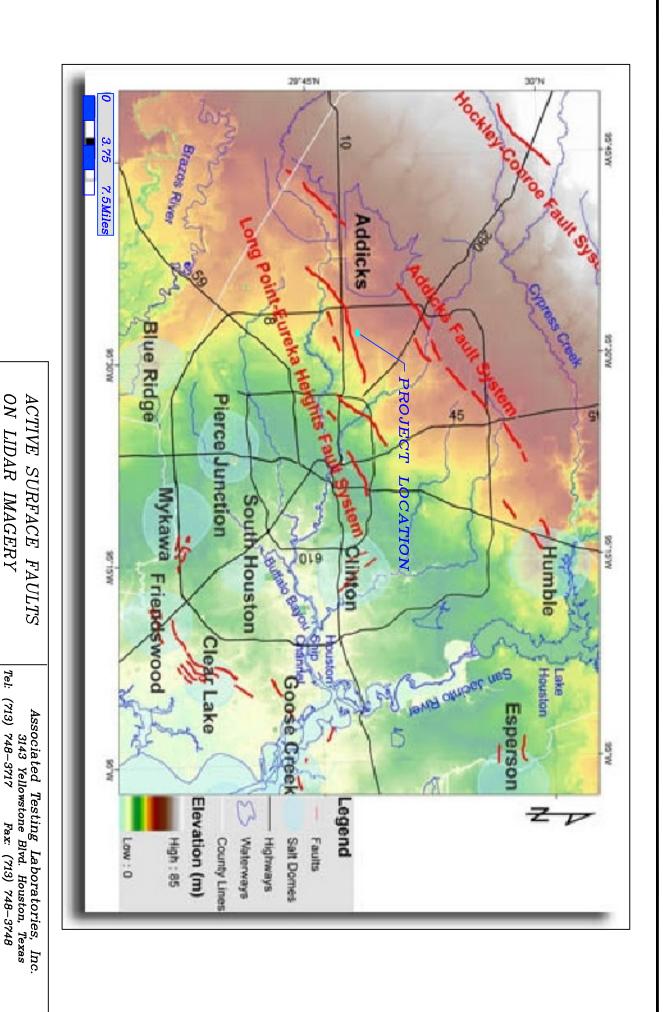
WATER LINE REPLACEMENT IN HAMMERLY AREA

ASSOICATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748

PROJECT NO. : G13-164

WBS No. S-00035-0180-3 FIGURE 2d





HAMMERLY AREA

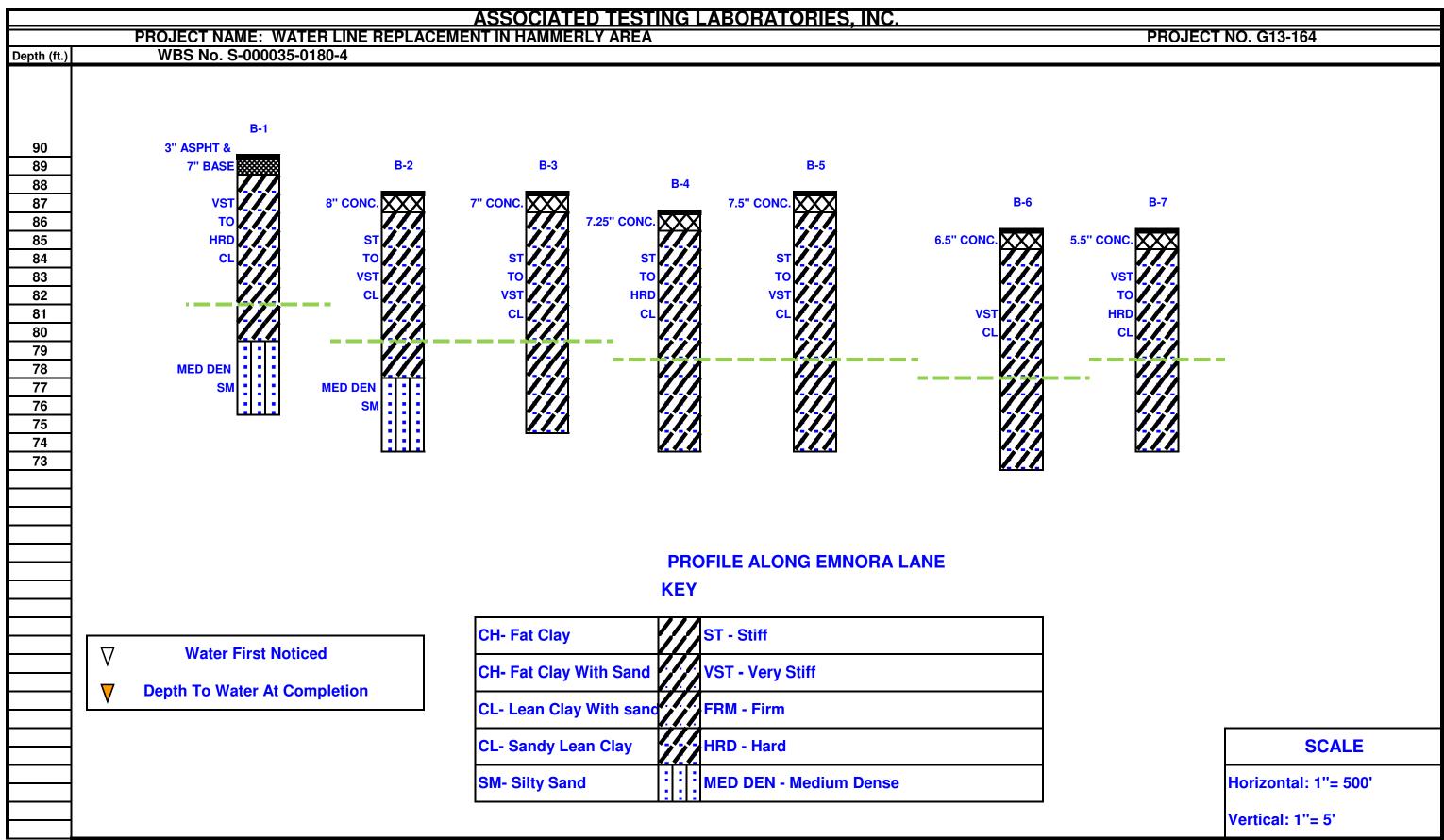
WATER LINE REPLACEMENT IN

WBS No.: S-000035-0180-4

PROJECT NO. G13-164

FIGURE. 3b

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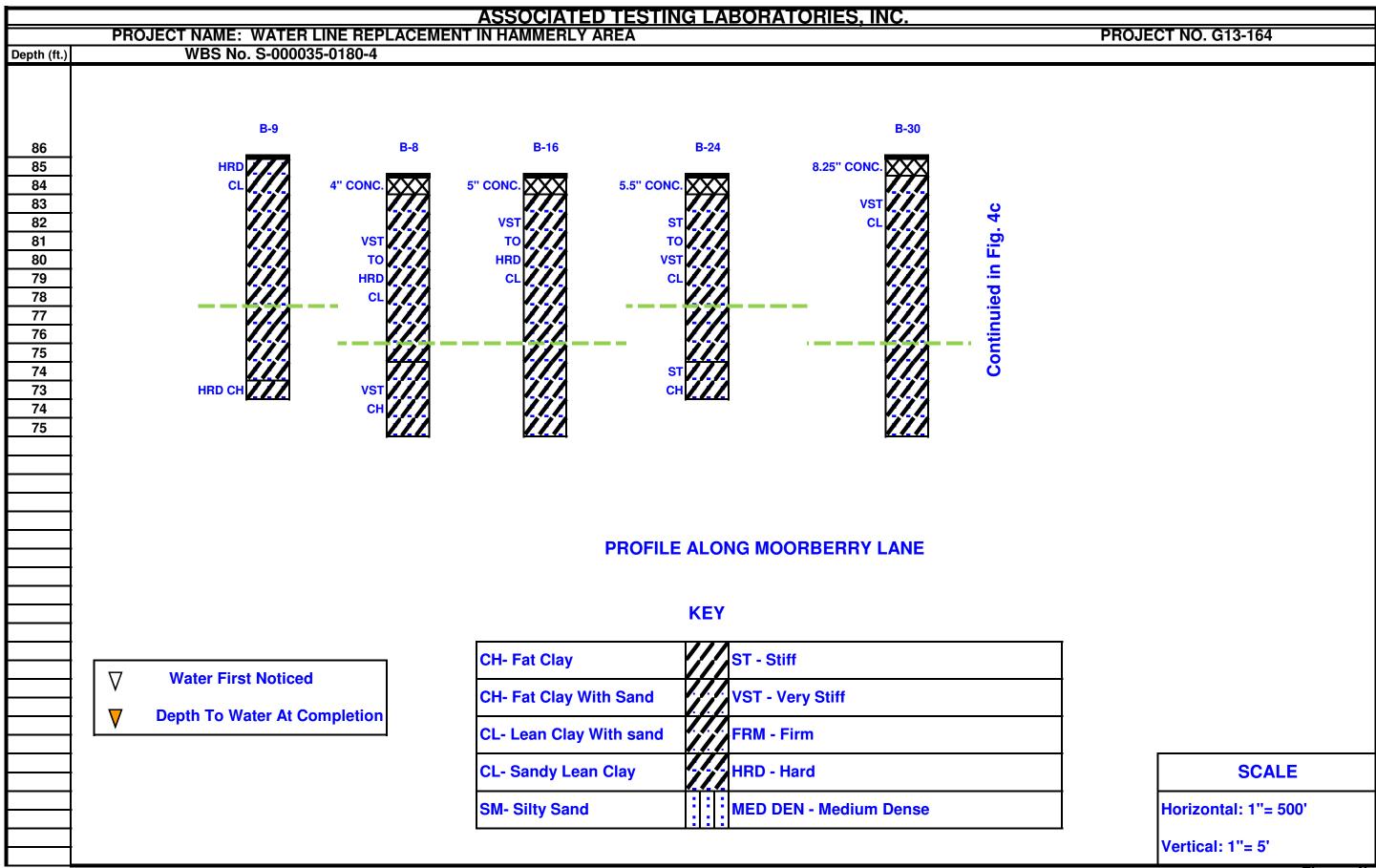
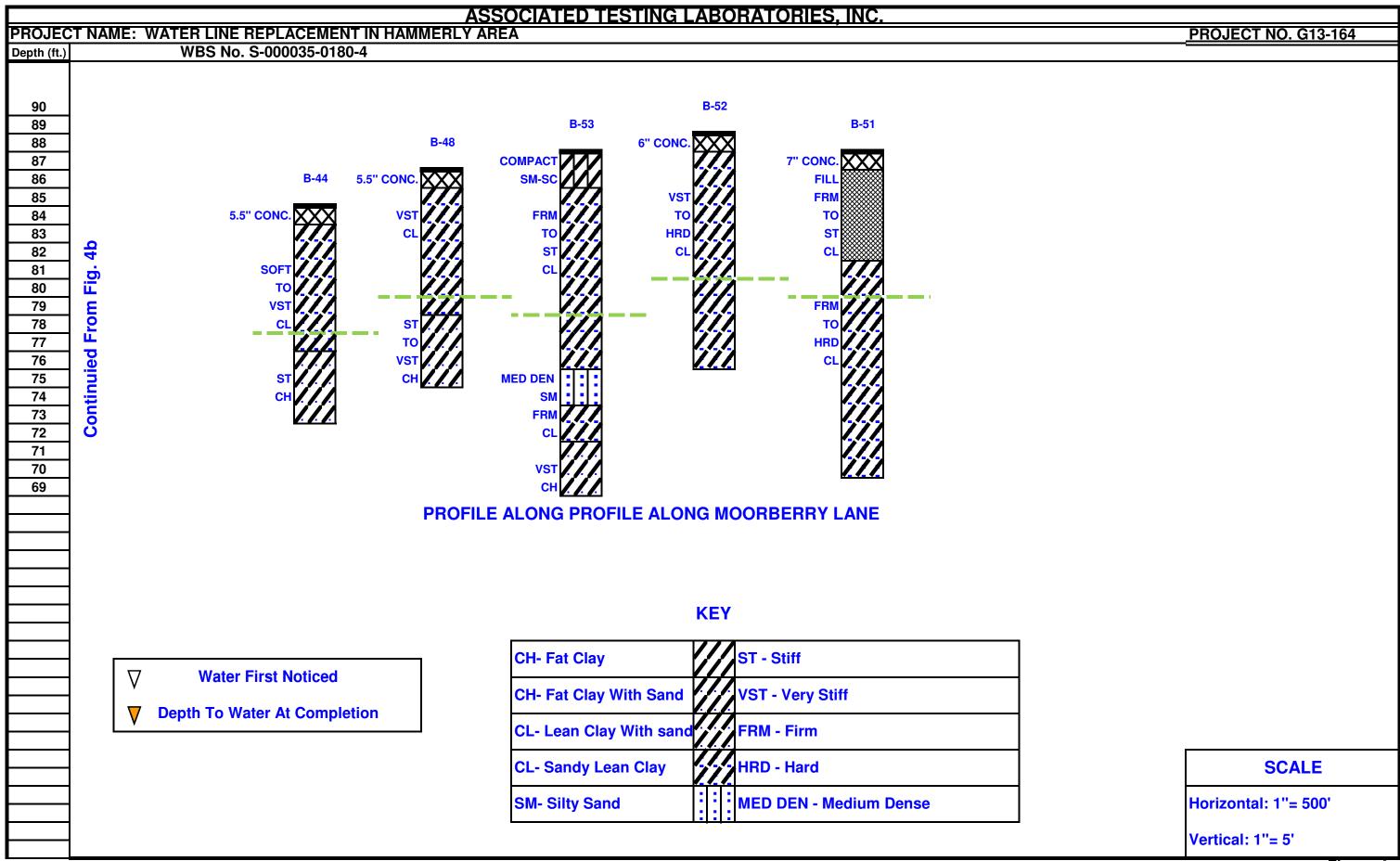


Figure-4b



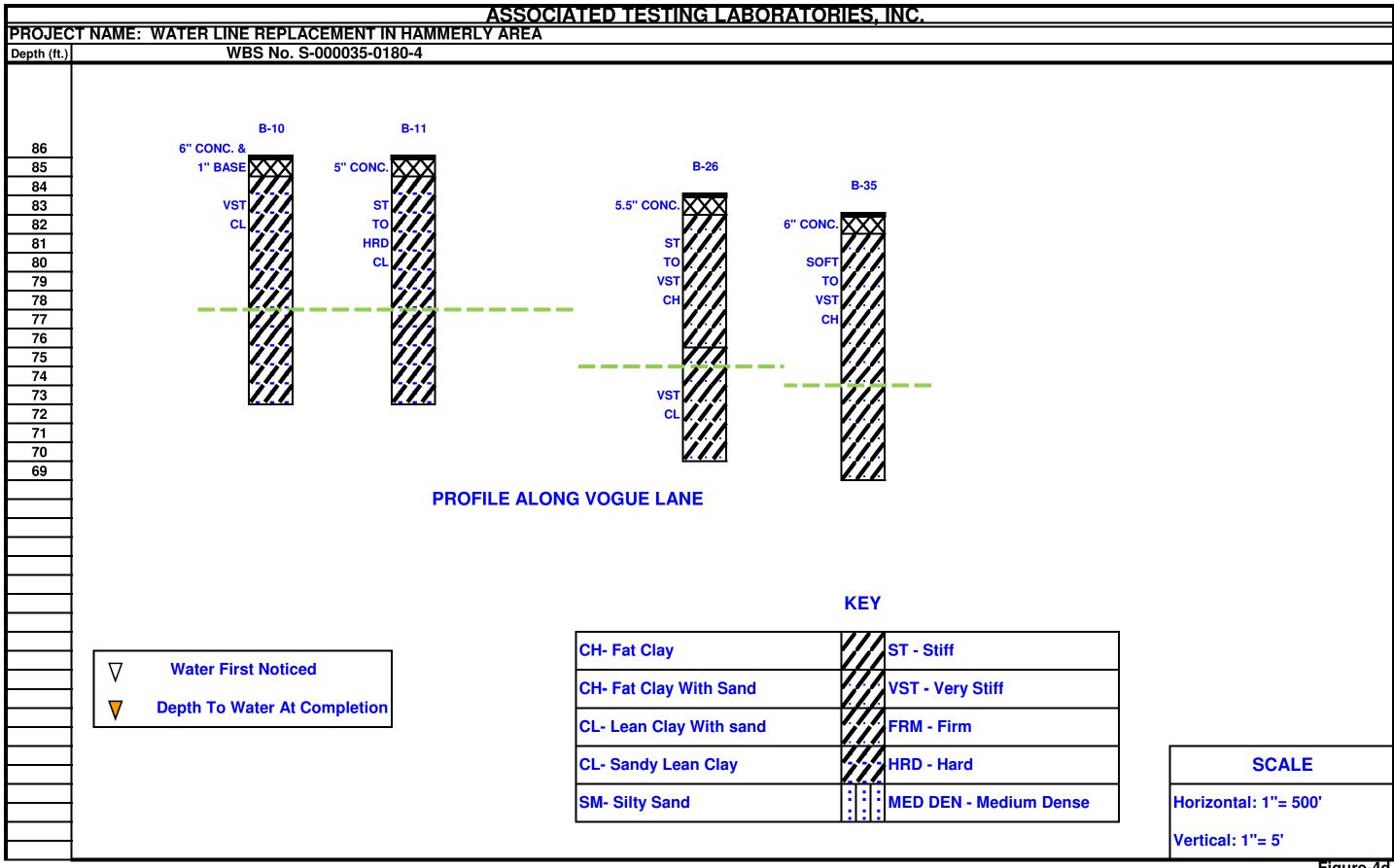
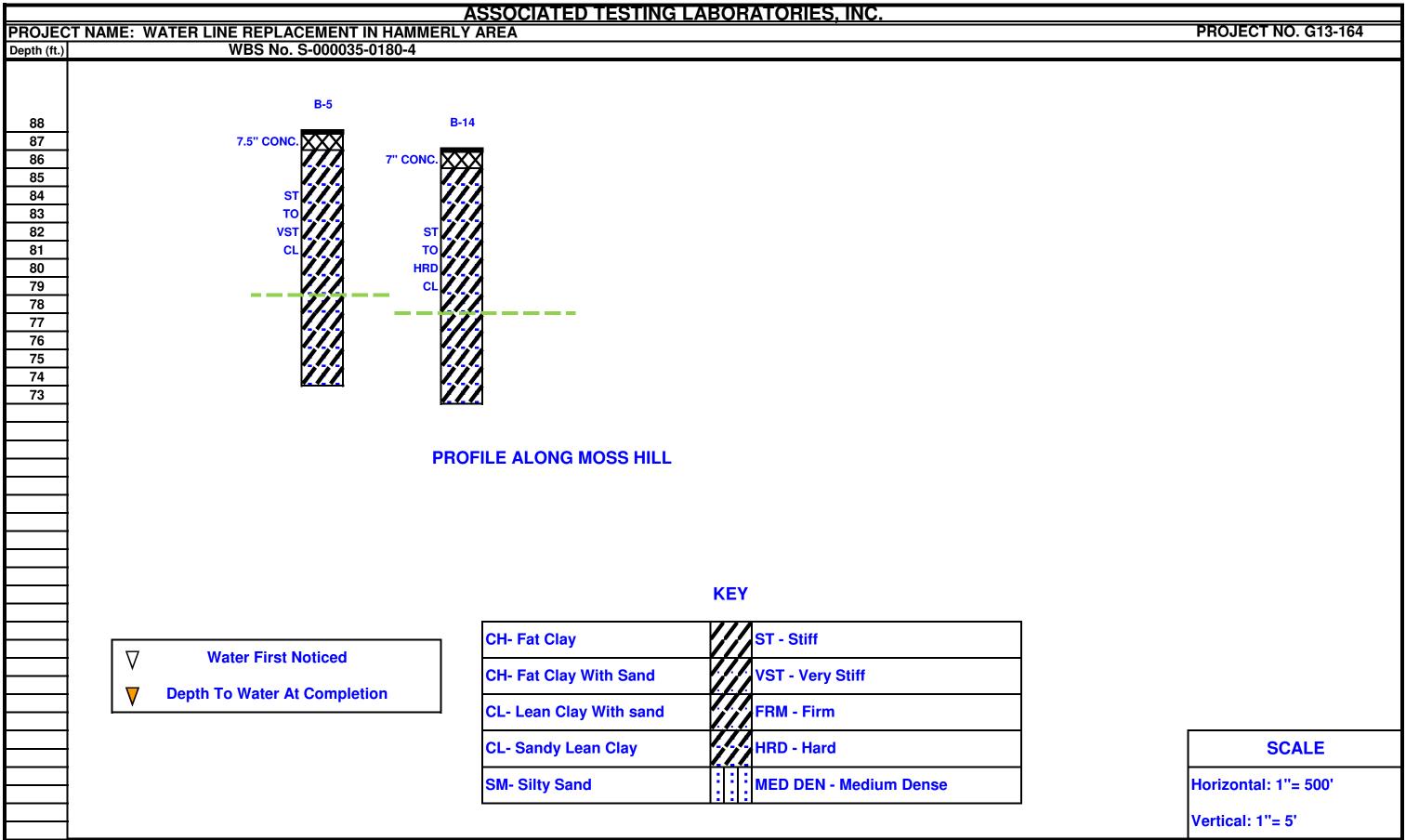
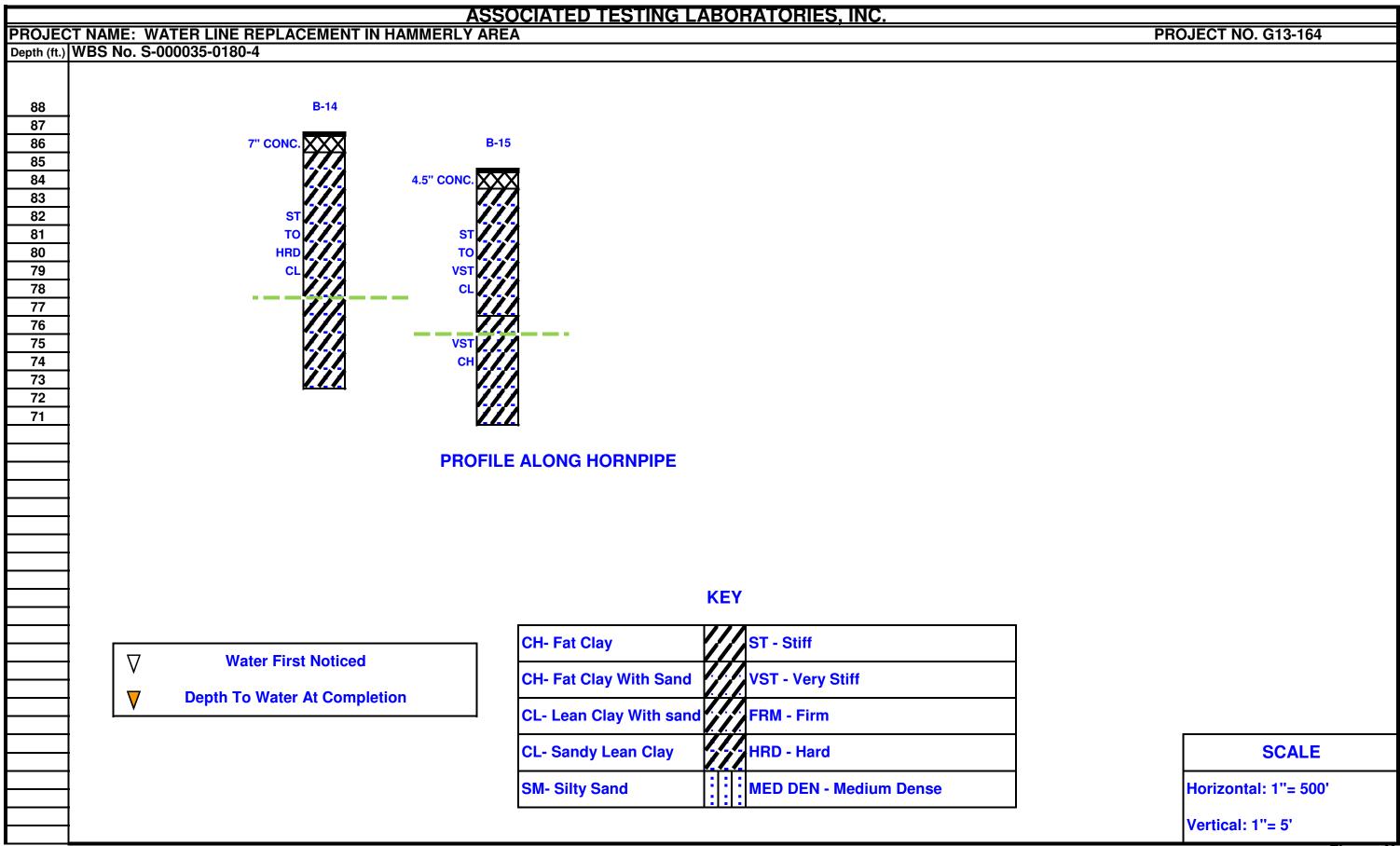
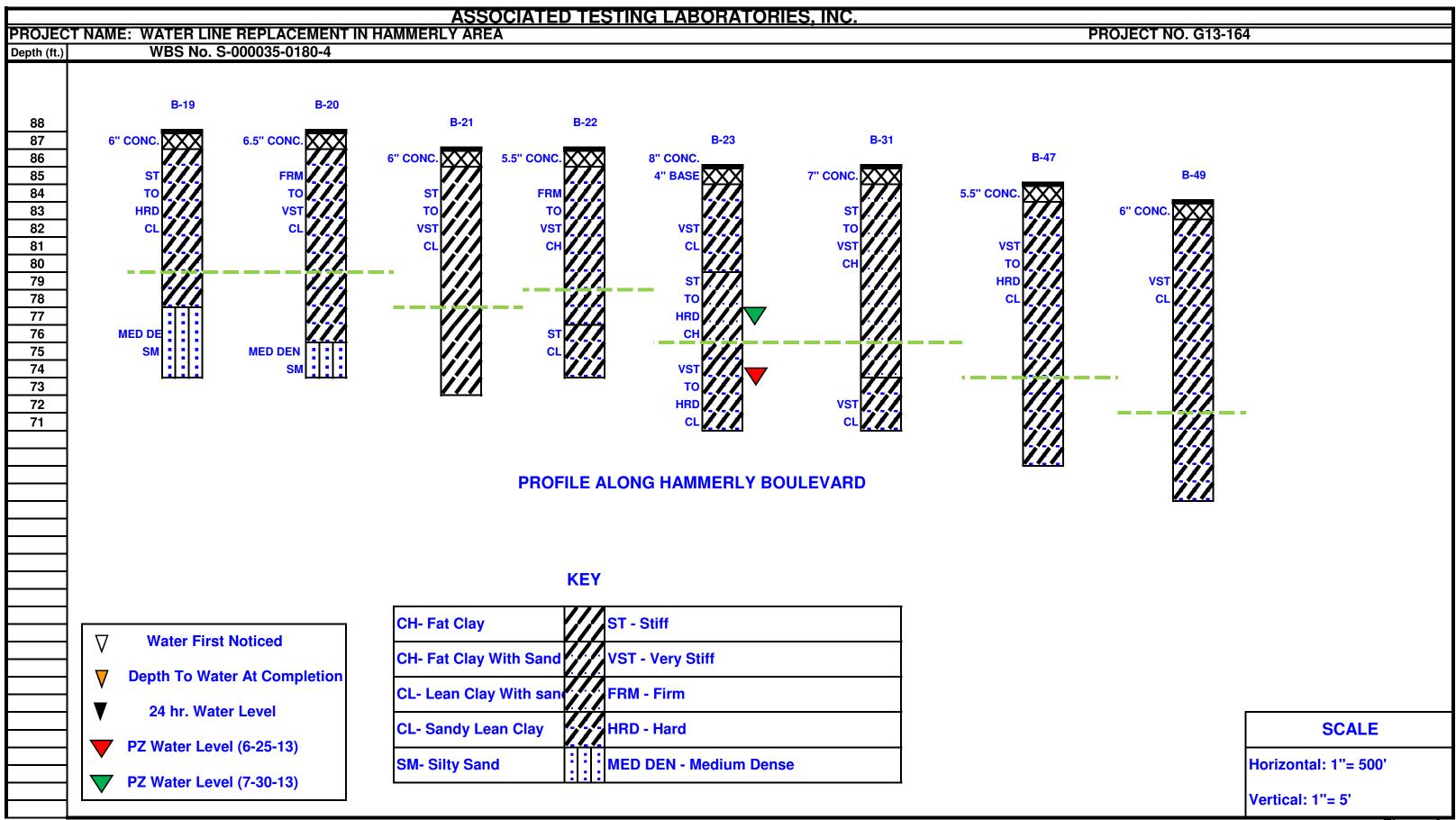
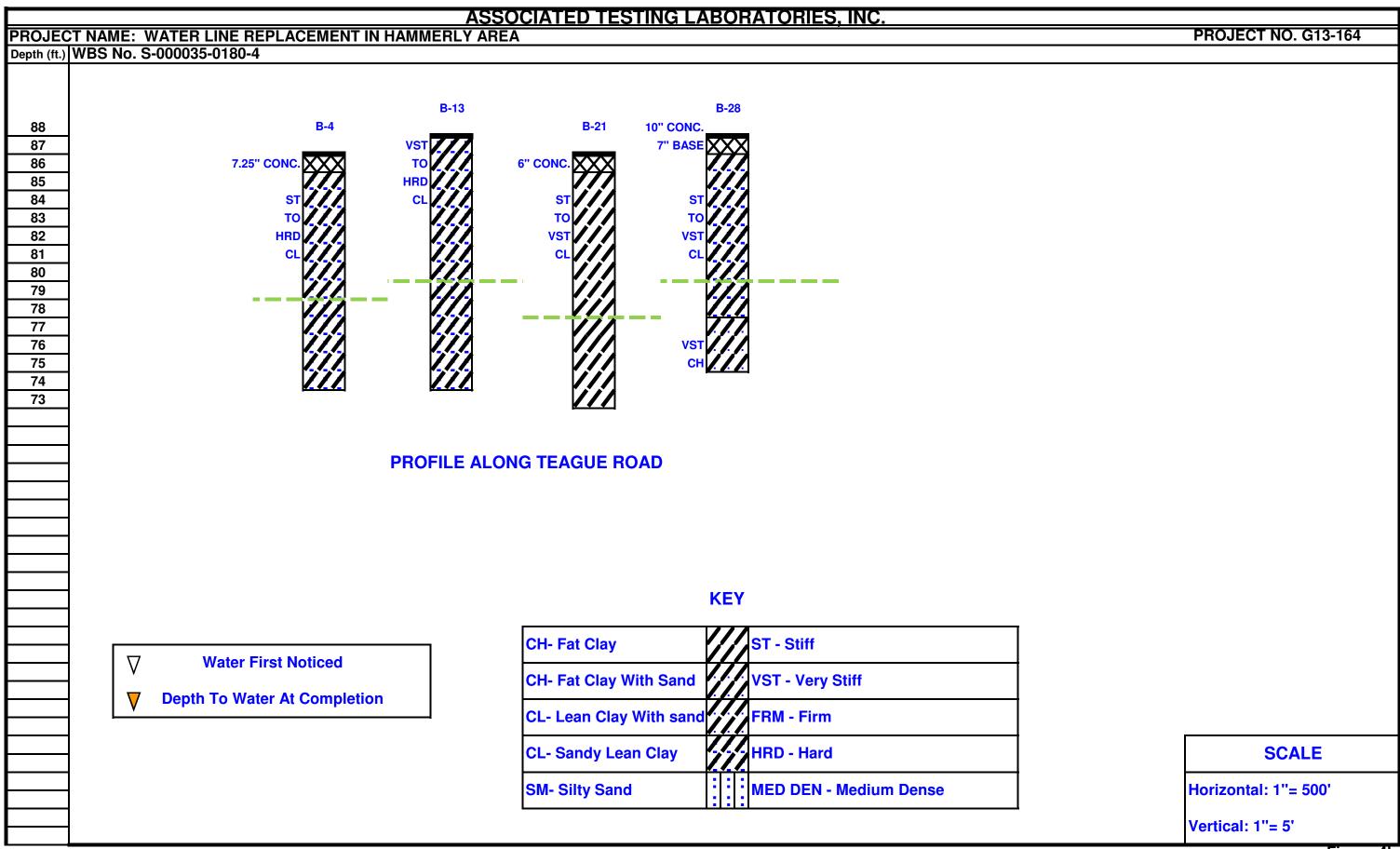


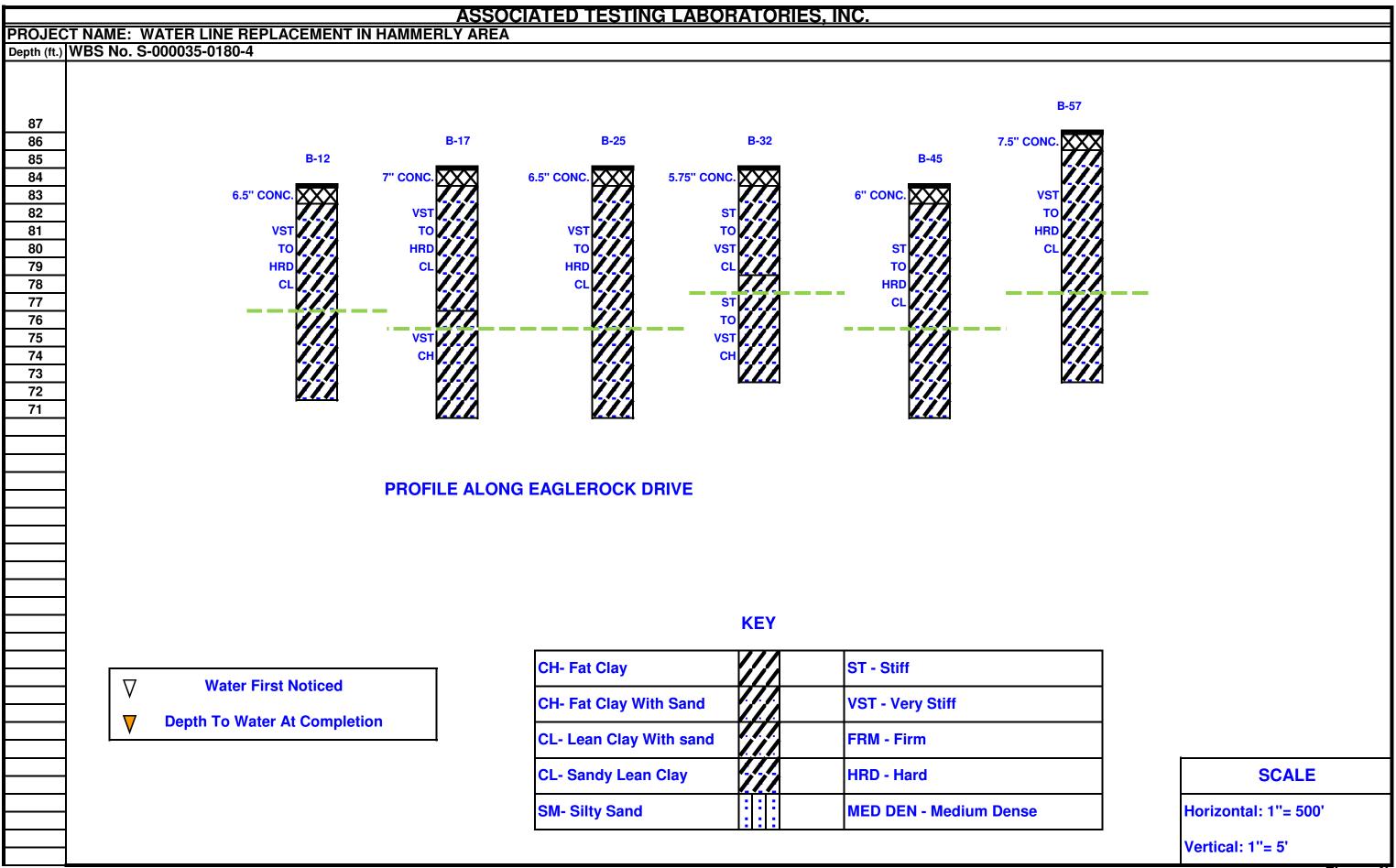
Figure-4d

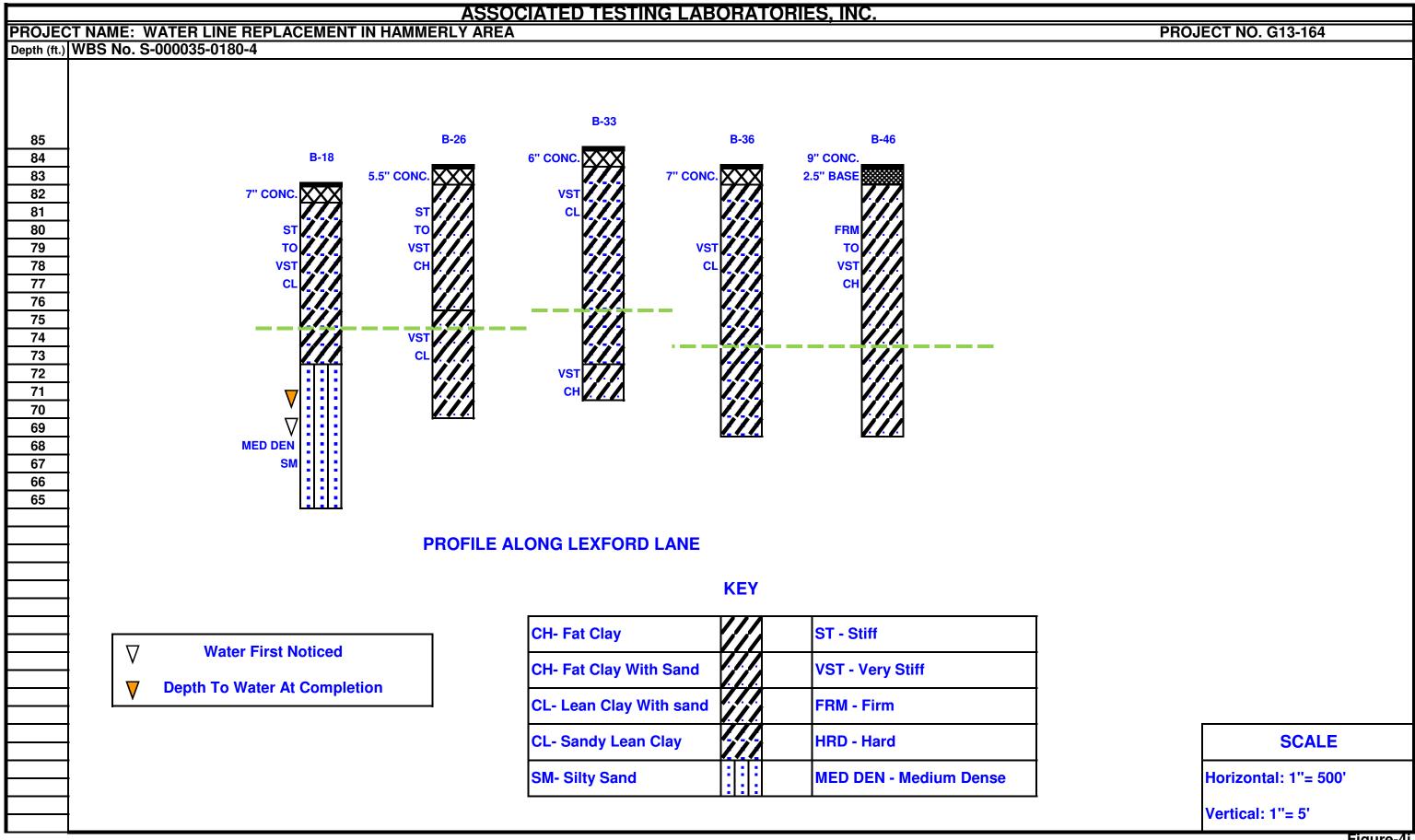


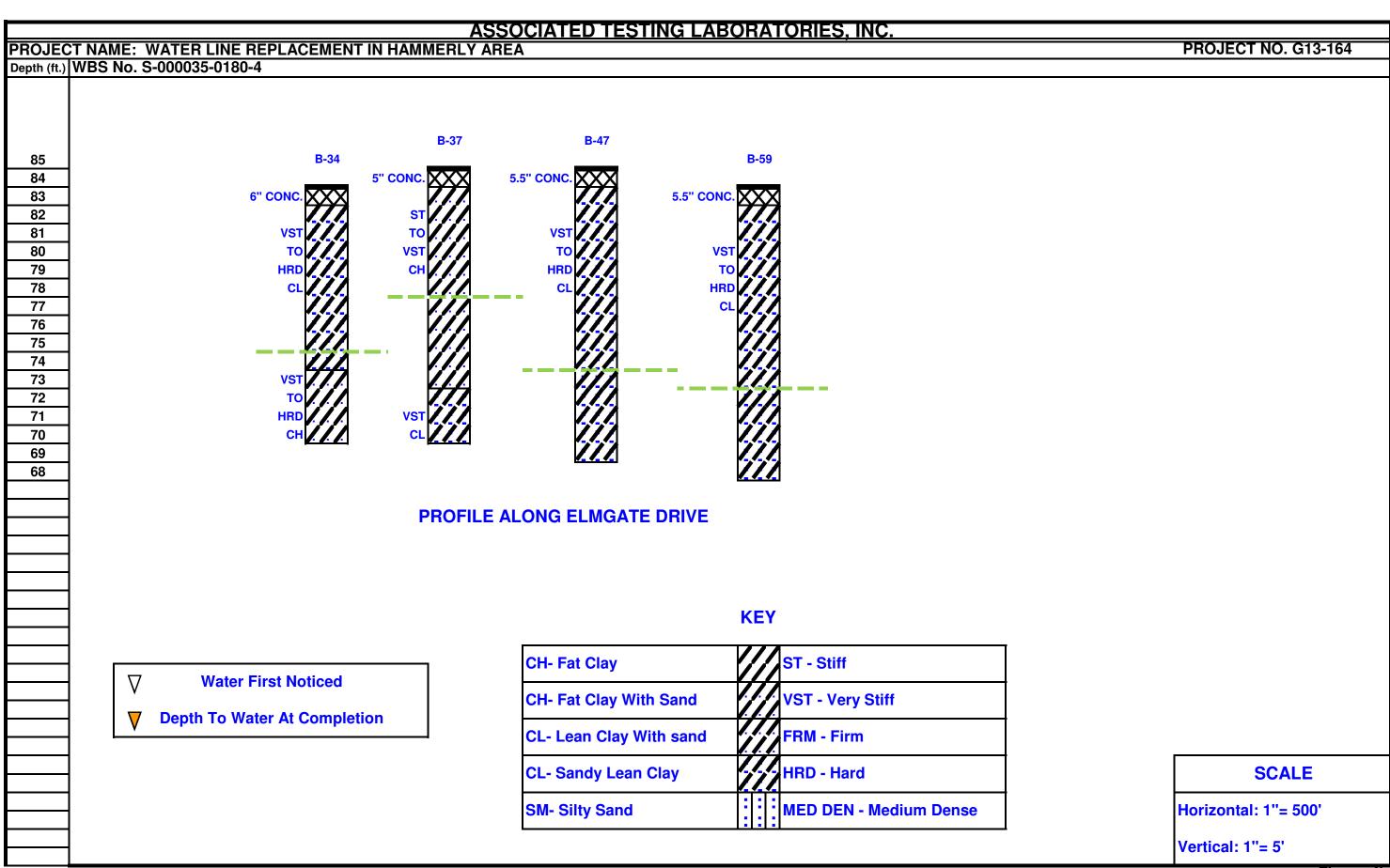


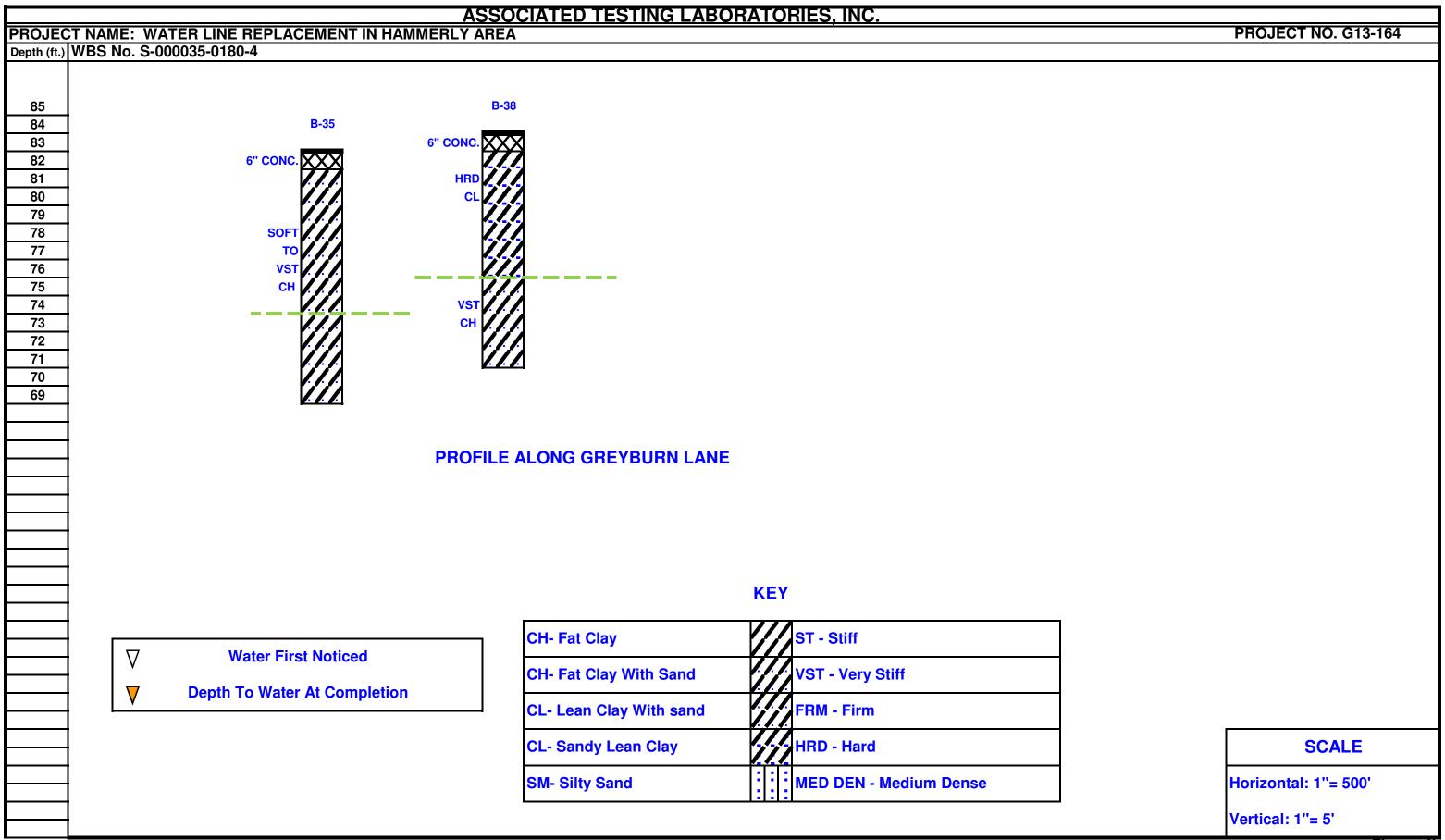


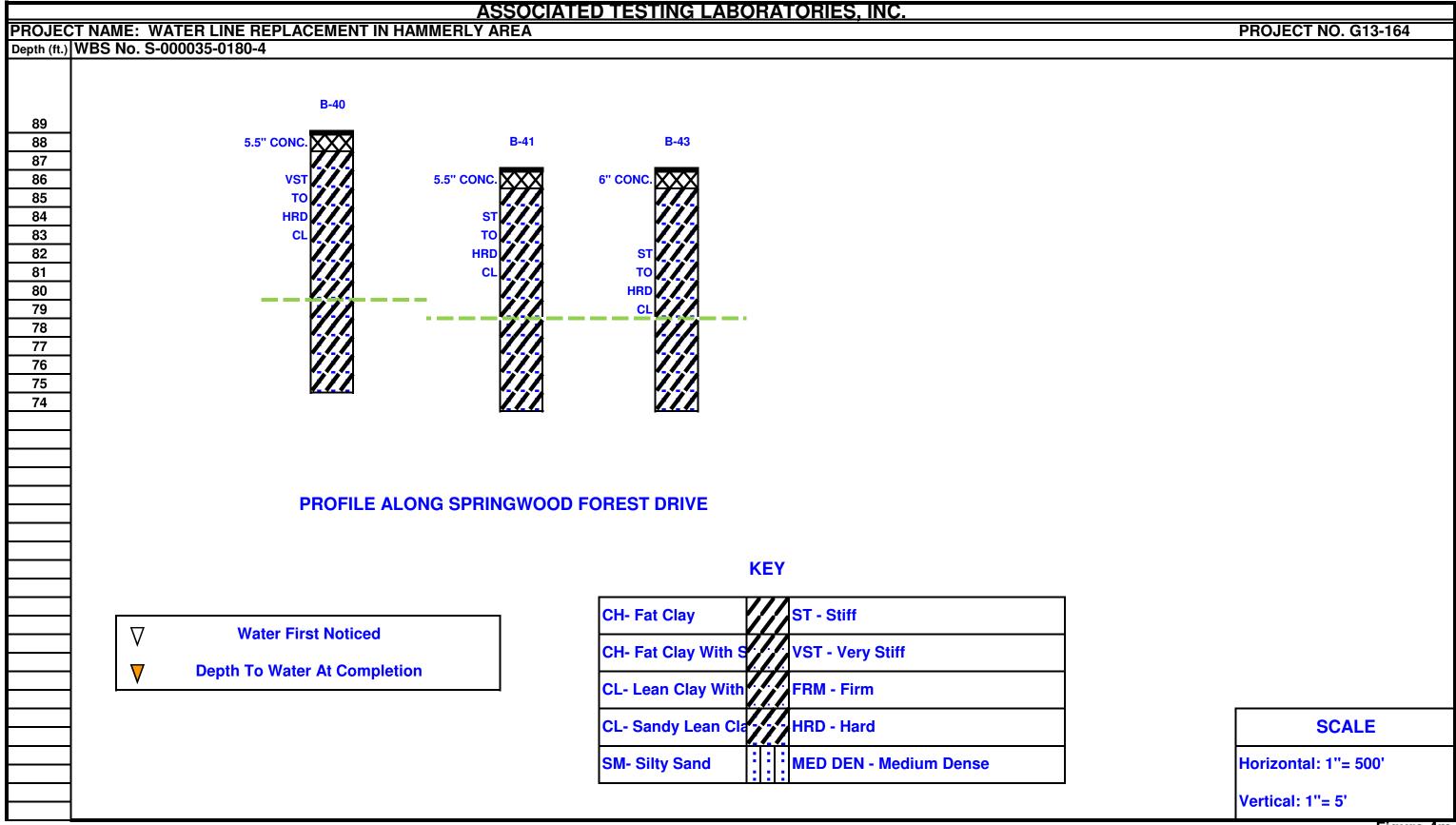


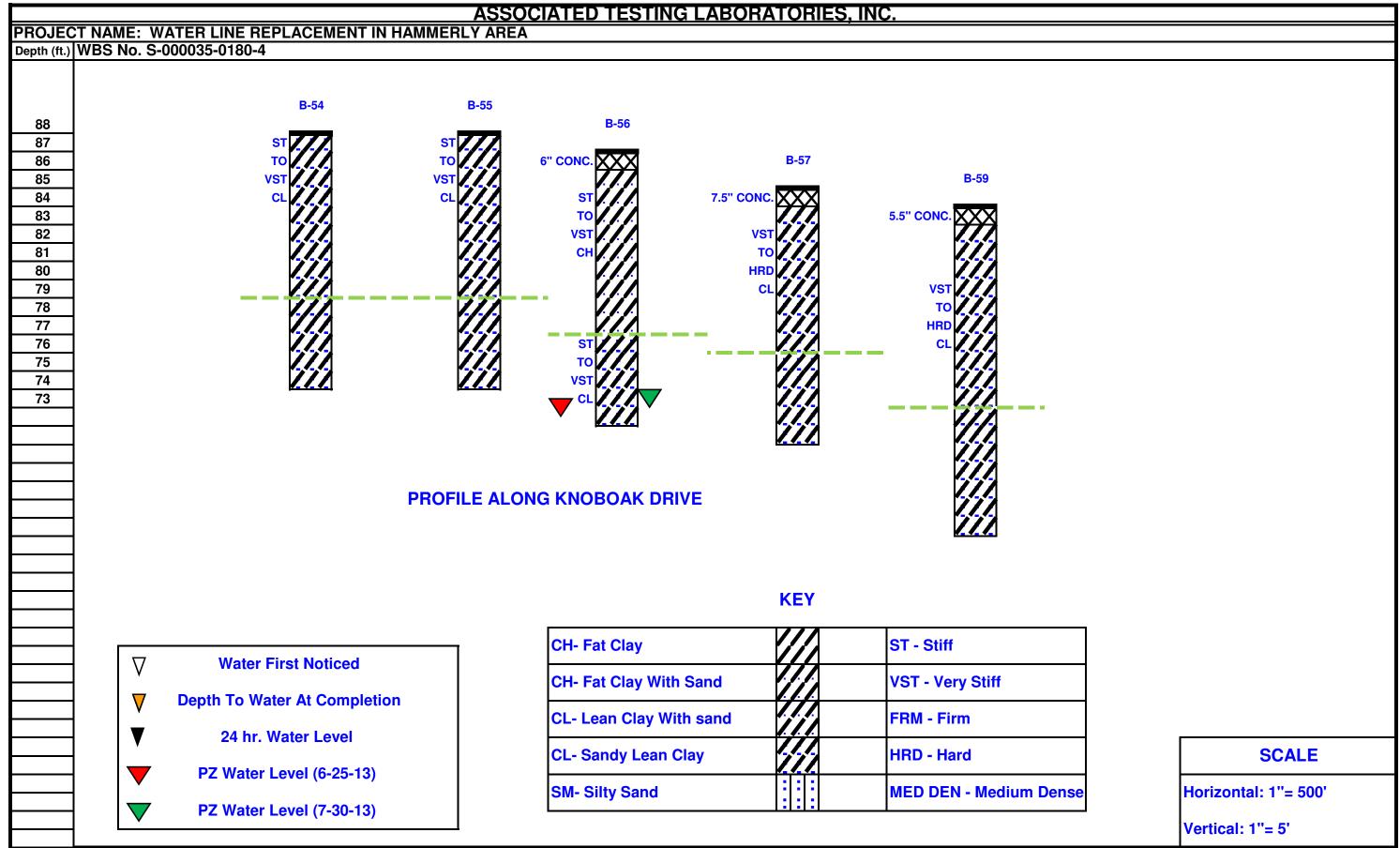


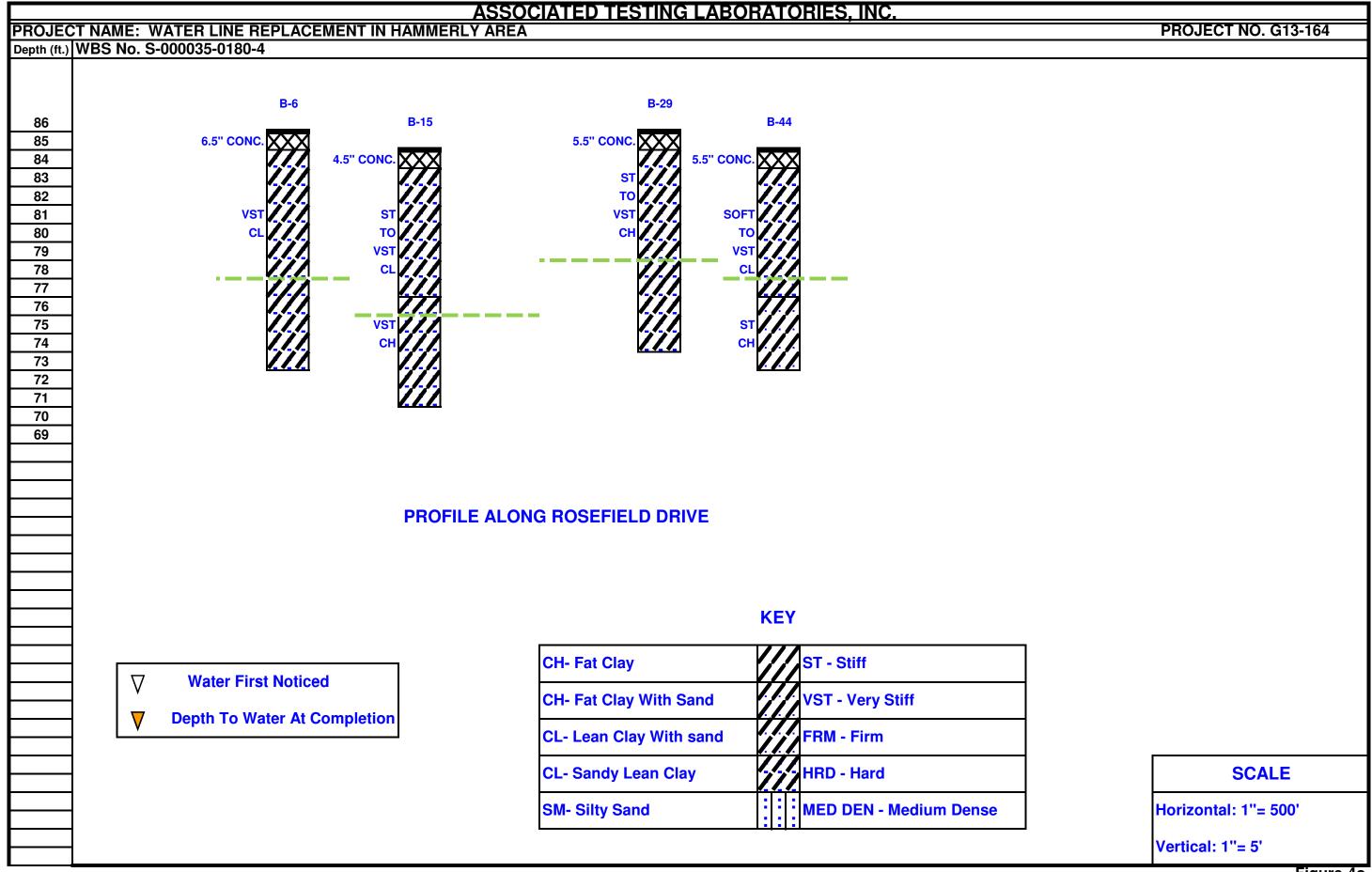


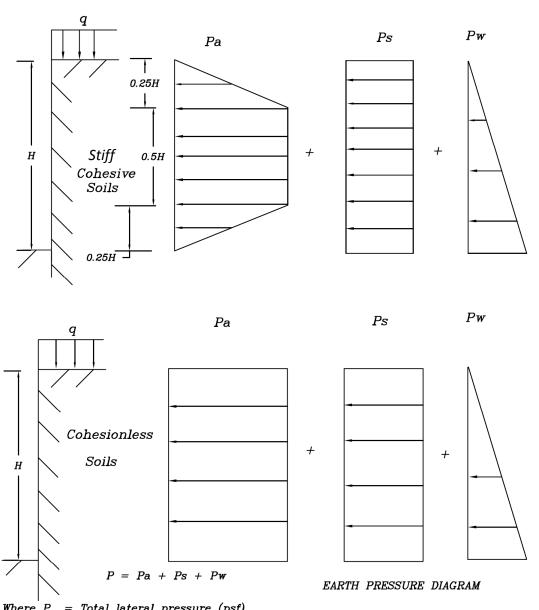












Where P = Total lateral pressure (psf)

 $Pa = Active earth pressure(psf) = K_A + H = 0.4 + H for Stiff Clays$ 

= 0.65 KA ×H = 0.25 ×H for cohesionless Sands (0.33 ×H-for loose sand) Ps = Lateral pressure due to surcharge load (psf) = 0.5q for Clays = 0.4q for Sands Pw = Hydrostatic pressure (psf) = 62.4\* water depth (0.5q for loose Sands)

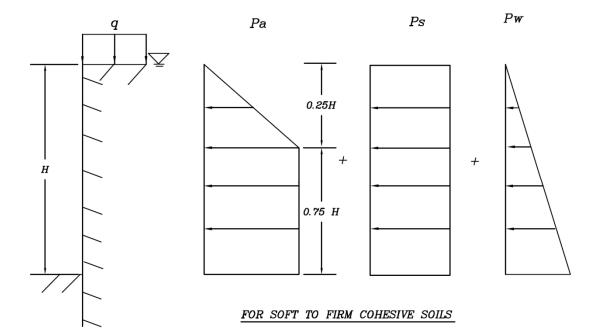
H = Depth of braced excavation (ft)

= Surcharge load (psf) usually taken as 500 psf

x = Submerged density of soils (pcf) = use 60 pcf (use 50 pcf for loose Sands)

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN HAMMERLY AREA	WBS NO. S-00035	-0180-3
WATER LINE REPEACEMENT IN HAMINIERE AREA	PROJECT NO. : G13-164	FIGURE 5a



Where P = Total lateral pressure (psf)

Pa = Active earth pressure(psf) = 1.0Ka×H for soft clays

Ka = Active Earth pressure coefficient

= 
$$1-m \frac{2 q_u}{\forall H}$$
 =  $1-m \frac{4C}{\forall H}$  (taking  $C=\frac{q_u}{2}$ )

Here m=1 for N<4 and m=0.4 for N>5

N= Stability number =  $\Im H/C$ 

 $Ps = Lateral pressure due to surcharge load (psf) = K_a for clays$ 

Pw = Hydrostatic pressure (psf) = 62.4\* water depth

H = Depth of braced excavation (ft)

q = Surcharge load (psf) usually taken as 500 psf

8 = density of soils (pcf) = use 50 pcf below groundwater and 110 pcf above

 $q_u$  = Unconfined compressive strength, psf

ground water

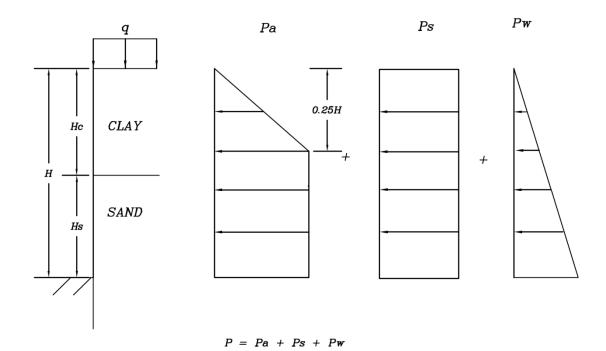
C = Undrained shear strength, psf

Note: Neglect hydrostatic pressure above groundwater level

Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REPLACEMENT IN HAMMERLY NORTH AREA	WBS NO. S-00035	-0180-3
WATER LINE REPEACEIVIENT IN HAMINIERE NORTH AREA	PROJECT NO. : G13-164	FIGURE 5b

PST 8/28/12



Where P = Total lateral pressure (psf)

 $Pa = Active earth pressure(psf) = K_A \forall H=0.4 \forall H$ 

Ps = Lateral pressure due to surcharge load (psf) = 0.5q

Pw = Hydrostatic pressure (psf) = 62.4\* water depth

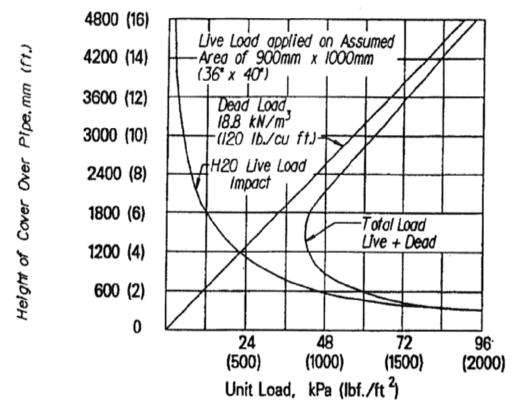
H = Depth of braced excavation (ft)

q = Surcharge load (psf) usually taken as 500 psf

8 = Submerged density of soils (pcf) = use 60 pcf

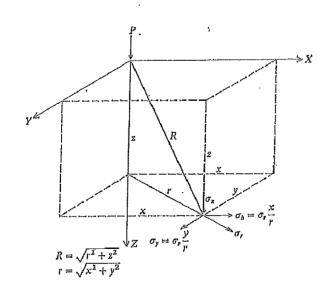
Source: Peck, R.B. 1969. "Deep Excavations and Tunneling in Soft Ground".

EARTH PRESSURE DIAGRAM	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748		
WATER LINE REPLACEMENT IN HAMMERLY AREA	WBS NO. S-00035	-0180-3	
WATER LINE REI LACEWENT IN HAMINIERE AREA	PROJECT NO. : G13-164	FIGURE 5c	



Combined H2O highway live load and dead load is a minimum at about 1500mm (5 ft.) of cover, applied through a pavement 300mm (1 ft.) thick.

HIGHWAY LOADING ON A PIPE UNDER VARIOUS SOIL COVER	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
VALATED LINE DEDI A CENAENT IN LIANANAEDIV A DEA	WBS NO. S-00035-0180-3	
WATER LINE REPLACEMENT IN HAMMERLY AREA	PROJECT NO. : G13-164	FIGURE 6

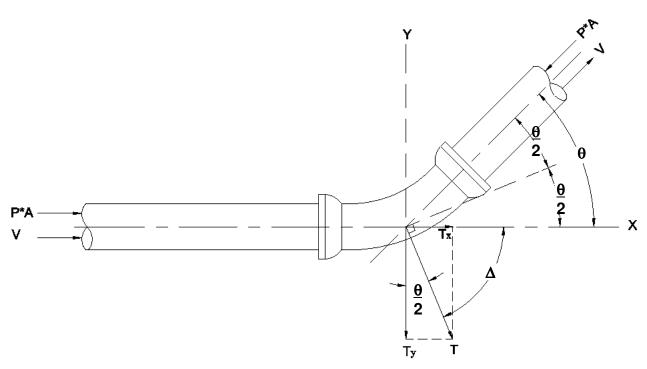


Later Pressure,  $\sigma_r$ :  $\sigma_r = (P/2\pi) \{3r^2Z/R^5\} - ([1-2\mu]/R[R+z]\}$  For  $\mu$ = 0.5,  $\sigma_r = P/2\pi \ (2r^2z/R^5)$ 

Vertical Pressure,  $\sigma_z$ :  $\sigma_z = 3 P z^3 / 2\pi R^5$ 

P = Point load surcharge  $\mu$  = Poisson's ratio if soils, use 0.5 X, y, z = distance in x, y and z direction, respectively

BOUSSINESQ'S EQUATION FOR POINT LOAD SURCHARGE	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	
WATER LINE REDI ACEMENT IN LIANAMERIN AREA	WBS NO. S-00035-0180-3	
WATER LINE REPLACEMENT IN HAMMERLY AREA	PROJECT NO. : G13-164	FIGURE 7



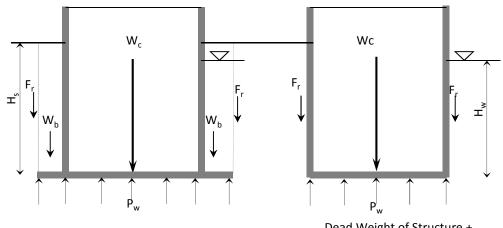
$$T = 2 P A \sin \frac{\theta}{2}$$
  
 $T_x = P A (1 - \cos \theta)$   
 $T_y = P A \sin \theta$ 

# Where:

Τ	=	Resultant thrust force, lbs
$T_x$	=	Resultant thrust force component along x-axis, lbs
$T_v$	=	Resultant thrust force component along y-axis, lbs
P	=	Maximum sustain pressure of fluid in pipe, psi
Α	=	Cross-section area of pipe, square inches
D	=	Inside diameter of pipe, inches
θ	=	Angle of the pipe bend, degrees
$\Delta$	=	Angle between x-axis and resultant force
	=	$tan^{-1} (T_y/T_x)$ , degrees
V	=	Fluid velocity

Source: American Water Works Association, "Concrete Pressure Pipes", AWWA Manual M9.

WATER LINE REI LACEWENT IN HAWIWERE AREA	PROJECT NO. : G13-164	FIGURE 8
WATER LINE REPLACEMENT IN HAMMERLY AREA	WBS NO. S-00035-0180-3	
THRUST FORCE AT A PIPE BEND	ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748	



Dead Weight of Structure + Dead Weight of Backfill Above Base Extension + Frictional Resistance

$$\begin{split} &P_{w} = \; H_{w}\gamma_{w} \\ &F_{u} = \; A_{b}P_{w} \\ &W_{c}/S_{fa} + W_{b}/S_{fb} + F_{r}/S_{fc} \; \geq \; F_{u} \\ &(S_{fa} = 1.1; \; S_{fb} = 1.5; \; S_{fc} = 3.0) \end{split}$$

Dead Weight of Structure + Frictional Resistance

$$\begin{aligned} P_{w} &= H_{w} \gamma_{w} \\ F_{u} &= A_{b} P_{w} \\ W_{c} / S_{fa} + F_{r} / S_{fc} \geq F_{u} \\ (S_{fa} &= 1.1; \ S_{fc} = 3.0) \end{aligned}$$

For cohesive soils:

$$F_r = \alpha c_n A_n$$

Where,  $For \ cohesionless \ soils, \\ Fr = p_n K tan \delta_n A_n$ 

		$Fr = p_n Ktan \delta_n A_n$
H <sub>s</sub>	=	Buried depth of wall, ft
H <sub>w</sub>	=	Height of water table above base of structure, ft
$P_{w}$	=	Total uplift pressure = 62.4 x Hw, psf
F <sub>u</sub>	=	Total uplift force exerted on base of structure = Pw x A <sub>b</sub>
W <sub>c</sub>	=	Dead weight of structure, lbs
$W_{b}$	=	Weight of backfill above base of structure, lbs
A <sub>b</sub>	=	Area of base, ft <sup>2</sup>
F <sub>r</sub>	=	Friction resistance developed at the soil/wall interface, lbs
An	=	Contact area between the soil/wall interface in layer"n"
C <sub>n</sub>	=	Undrained shear strength of cohesive soils at layer "n" at soil/wall interface.
		See individual boring logs. $c_n$ for the top 8 ft of clays with PI higher than 20
		percent should be discounted because of the shrink-swell characteristics of
		high plasticity clays.
α	=	Adhesion factor, to be multiplied with $c_n$ to obtain the adhesion between the
		soil/wall interface. Use 0.75 if $c_n$ is less than 0.25 tsf, use 0.67 if $c_n$ is
		between 0.25 and 0.5 tsf, use 0.5 if c <sub>n</sub> is greater than 0.5 tsf but limit the
		adhesion to 1.5 ksf.
K	=	Coefficient of lateral earth pressure of cohesionless soils. Use 0.4.
p <sub>n</sub>	=	Average overburden stress at the mid-depth of cohesionless soil layer "n", psf

BUOYANT UPLIFT RESISTANCE OF A BURIED STRUCTURE	3143 YELLOWSTONE BLVD HOLISTON TEXA	
WATER LINE REPLACEMENT IN HAMMERLY AREA	WBS NO. S-00035-0180-3	
WATER LINE REFEACEMENT IN HAMINIERE AREA	PROJECT NO. : G13-164	FIGURE 9

Factors of safety against buoyant uplift force.

Average frictional angle between cohesionless soil layer "n" and the walls of the structure, use 0.75 of the angle of internal friction  $(\phi)$  of the cohesionless

soil. A  $\phi$  of 28 degrees may be used if no specific value is given.

 $S_{\text{fa,b,c}}$ 

# LIST OF TABLES

TABLE 1	SUMMARY OF EXISTING PAVEMENT MEASUREMENTS
TABLE 2	SUMMARY OF GROUNDWATER MEASUREMENTS
TABLE 3	SUMMARY OF TEST RESULTS
TABLE 4	MARSTON SOIL COEFFICIENT (Cd) FOR TRENCH CONDUITS

# TABLE 1 SUMMARY OF PAVEMENT MEASUREMENTS PROPOSED WATER LINE REPLACEMENT IN HAMMERLY AREA WBS NO. S-000035-0180-3 CITY OF HOUSTON ATL PROJECT NO. G13-164

Boring	Boring	Piezo	ometer	Asphalt	Concrete	Base
Number	Depth	No.	Depth	Paving (inch)	Paving	Material
	(ft)		(ft)		(inch)	(inch)
B-1	13.5			_		7" Gravel
D-1	13.3			3		with sand
B-2	13.5				8	
B-3	13				7	
B-4	13				7.25	
B-5	14				7.5	
B-6	13				6.5	
B-7	12				5.5	
B-8	14				4	
B-9	13					
B-10	13				6	1" Stabilized gravel
B-11	13				5	
B-12	12				6.5	
B-13	13					
B-14	14				7	
B-15	14				4.5	
B-16	14				5	
B-17	14				7	
B-18	18				7	
B-19	13.5				6	
B-20	13.5				6.5	
B-21	14				6	
B-22	13				5.5	
B-23	15	PZ-1	15		8	4" Crushed
(PZ-1)	13	121			o	limestone
B-24	12				5.5	
B-25	14				6.5	
B-26	14				5.5	
B-27	12				5.5	
B-28	13				10	7" Stabilized soil with lime
B-29	12				5.5	
B-30	15				8.25	

# TABLE 1 SUMMARY OF PAVEMENT MEASUREMENTS PROPOSED WATER LINE REPLACEMENT IN HAMMERLY AREA

# WBS NO. S-000035-0180-3 CITY OF HOUSTON ATL PROJECT NO. G13-164

Boring	Boring	Piezometer		Asphalt	Concrete	Base
Number	Depth	No.	Depth	Paving (inch)	Paving	Material
	(ft)		(ft)		(inch)	(inch)
B-31	15				7	
B-32	12				5.75	
B-33	14				6	
B-34	14				6	
B-35	14				6	
B-36	15				7	
B-37	15				5	
B-38	13				6	
B-39	14				6	
B-40	14				5.5	
B-41	13				5.5	
B-42	13				7	
B-43	13				6	
B-44	12				5.5	
B-45	13				6	
B-46	15				9	2.5" Crushed limestone
B-47	16				5.5	
B-48	12				5.5	
B-49	17				6	
B-50 (PZ-2)	17	PZ-2	17		6	
B-51	18				7	
B-52	13				6	
B-53	19					
B-54	14					
B-55	14					
B-56	15	PZ-3	15		6	
(PZ-3)						
B-57	14				7.5	
B-58	13				5.5	
B-59	16				5.5	

# TABLE 2

# SUMMARY OF GROUNDWATER MEASUREMENTS PROPOSED WATER LINE REPLACEMENT IN HAMMERLY AREA WBS NO. S-000035-0180-3 CITY OF HOUSTON,TEXAS

# ATL PROJECT NO. G13-164

Boring Number	Location	Ground water during drilling	Ground water upon completion of drilling	Ground water in Piezometer ( after 24 hrs )	Ground water in Piezometer ( after 7 days )	Ground water in Piezometer ( after 30 days )
B-1	Emnora Ln.	Dry	Dry			
B-2	Emnora Ln.	Dry	Dry			
B-3	Emnora Ln.	Dry	Dry			
B-4	Emnora Ln.	Dry	Dry			
B-5	Emnora Ln.	Dry	Dry			
B-6	Emnora Ln.	Dry	Dry			
B-7	Emnora Ln.	Dry	Dry			
B-8	Moorberry Ln.	Dry	Dry			
B-9	Moorberry Ln.	Dry	Dry			
B-10	Vogue Ln.	Dry	Dry			
B-11	Vogue Ln.	Dry	Dry			
B-12	Eaglerock Dr.	Dry	Dry			
B-13	Teague Rd.	Dry	Dry			
B-14	Moss Hill Dr.	Dry	Dry			
B-15	Rosefield Dr.	Dry	Dry			
B-16	Moorberry Ln.	Dry	Dry			
B-17	Eaglerock Dr.	Dry	Dry			
B-18	Lexford Ln.	14'	*caved in at 12.5'			
B-19	Hammerly Blvd.	Dry	Dry			
B-20	Hammerly Blvd.	Dry	Dry			
B-21	Hammerly Blvd.	Dry	Dry			
B-22	Hammerly Blvd.	Dry	Dry			
B-23	Hammerly Blvd.	Dry	Dry	Dry	12.5'	9'
(PZ-1)				( 6/18/2013)	(6/25/2013)	(7/30/13)
B-24	Moorberry Ln.	Dry	Dry			
B-25	Eaglerock Dr.	Dry	Dry			
B-26	Lexford Ln.	Dry	Dry			
B-27	Longhorn Dr.	Dry	Dry			
B-28	Teague Rd.	Dry	Dry			
B-29	Rosefield Dr.	Dry	Dry			
B-30	Moorberry Ln.	Dry	Dry			

#### TABLE 2

# SUMMARY OF GROUNDWATER MEASUREMENTS PROPOSED WATER LINE REPLACEMENT IN HAMMERLY AREA WBS NO. S-000035-0180-3 CITY OF HOUSTON,TEXAS

### ATL PROJECT NO. G13-164

Boring Number	Location	Ground water during drilling	Ground water upon completion of drilling	Ground water in Piezometer ( after 24 hrs )	Ground water in Piezometer ( after 7 days )	Ground water in Piezometer ( after 30 days )
B-31	Hammerly Blvd.	Dry	Dry			
B-32	Eaglerock Dr.	Dry	Dry			
B-33	Lexford Ln.	Dry	Dry			
B-34	Elmgate Dr.	Dry	Dry			
B-35	Vogue Ln.	Dry	Dry			
B-36	Lexford Ln.	Dry	Dry			
B-37	Elmgate Dr.	Dry	Dry			
B-38	Greyburn Ln.	Dry	Dry			
B-39	Parana Dr.	Dry	Dry			
B-40	Springwood Forest Dr.	Dry	Dry			
B-41	Springwood Forest Dr.	Dry	Dry			
B-42	Hollow Hook Rd.	Dry	Dry			
B-43	Springwood Forest Dr.	Dry	Dry			
B-44	Rosefield Rd.	Dry	Dry			
B-45	Eaglerock Dr.	Dry	Dry			
B-46	Lexford Ln.	Dry	Dry			
B-47	Elmgate Dr.	Dry	Dry			
B-48	Moorberry Ln.	Dry	Dry			
B-49	Hammerly Blvd.	Dry	Dry			
B-50 (PZ-2)	Truscon Dr.	Dry	Dry	Dry ( 6/18/2013)	16' (6/25/2013)	16' (7/30/13)
B-51	Moorberry Ln.	Dry	Dry			
B-52	Moorberry Ln.	Dry	Dry			
B-53	Moorberry Ln.	Dry	Dry			
B-54	Knoboak Dr.	Dry	Dry			
B-55	Knoboak Dr.	Dry	Dry			
B-56 (PZ-3)	Knoboak Dr.	Dry	Dry	Dry ( 6/18/2013)	14.5' (6/25/2013)	14' (7/30/13)
B-57	Knoboak Dr.	Dry	Dry			
B-58	Canoga Ln.	Dry	Dry			
B-59	Knoboak Dr.	Dry	Dry			

#### TABLE 3

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 FAX: (713) 748-3748 CONSULTANT PROJECT NUMBER: G13-164 TEL: (713) 748-3717

		Sample	Э		(%)	(bct)	Atter	berg L	imits		UNDRAIN	ED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	DEPTH (ft)	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	ור	PL	Ē	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-1	1	0-2	UD		11		33	16	17	52				3.50	Sandy Lean Clay (CL)
	2	2-4	UD		10									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		8	117					2.25			4.50	Sandy Lean Clay (CL)
	4	6-8	UD		10									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		13		36	17	19					4.50	Sandy Lean Clay (CL)
	6	10-12	SS	17	13										Silty Sand (SM)
	7	12-13.5	SS	17	17					48					Silty Sand (SM)
B-2	1	0-2	UD		14									2.00	Sandy Lean Clay (CL)
	2	2-4	UD		14	118	35	16	19	53	0.85			2.50	Sandy Lean Clay (CL)
	3	4-6	UD		15									3.00	Sandy Lean Clay (CL)
	4	6-8	UD		17	114					0.55			2.00	Sandy Lean Clay (CL)
	5	8-10	UD		16									2.00	Sandy Lean Clay (CL)
	6	10-12	SS	18	13					21					Silty Sand (SM)
	7	12-13.5	SS	19	16										Silty Sand (SM)
B-3	1	0-2	UD		17		44	18	26	61				2.00	Sandy Lean Clay (CL)
	2	2-4	UD		17	110					0.95			2.50	Sandy Lean Clay (CL)
	3	4-6	UD		16									1.50	Sandy Lean Clay (CL)
	4	6-8	UD		17									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		17	113						1.58(0.43)		3.00	Sandy Lean Clay (CL)
	6	10-12	UD		17		38	17	21	52		Í		3.50	Sandy Lean Clay (CL)
	7	12-13	UD		16									2.00	Sandy Lean Clay (CL)

Legend:

UD - Undisturbed Sample Extruded in Field UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

AG - Auger Cutting in Field SS - Split Spoon Sample SPT - Standard Penetration Test

ASSOCIATED TESTING LABORATORIES, INC.

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 **CONSULTANT PROJECT NUMBER: G13-164** TEL: (713) 748-3717 FAX: (713) 748-3748

		Sample	9		(%)	(pcf)	Atter	berg L	imits		UNDRAIN	ED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	DEPTH (ft)	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	ור	PL	۵	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-4	1	0-2	UD		11		34	16	18	58				4.50	Sandy Lean Clay (CL)
	2	2-4	UD		12									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		13									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		15									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		16	114					1.95			4.50	Sandy Lean Clay (CL)
	6	10-12	UD		21		48	18	30	70				1.75	Sandy Lean Clay (CL)
	7	12-13	UD		17									2.00	Sandy Lean Clay (CL)
B-5	1	0-2	UD		17									3.00	Sandy Lean Clay (CL)
	2	2-4	UD		18		42	18	24	68				2.50	Sandy Lean Clay (CL)
	3	4-6	UD		15									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		16									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		20	110					1.25			3.50	Sandy Lean Clay (CL)
	6	10-12	UD		19		37	17	20	68				2.00	Sandy Lean Clay (CL)
	7	12-14	UD		17									1.50	Sandy Lean Clay (CL)
B-6	1	0-2	UD		17		39	17	22	61				4.00	Sandy Lean Clay (CL)
	2	2-4	UD		12									4.00	Sandy Lean Clay (CL)
	3	4-6	UD		14									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		15	116					1.60			4.00	Sandy Lean Clay (CL)
	5	8-10	UD		14	116						1.33(0.43)		2.50	Sandy Lean Clay (CL)
	6	10-12	UD		16		47	18	29			i '		4.00	Sandy Lean Clay (CL)
	7	12-13	UD		18									3.50	Sandy Lean Clay (CL)

Legend:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 **CONSULTANT PROJECT NUMBER: G13-164** TEL: (713) 748-3717 FAX: (713) 748-3748 (bct) **Atterberg Limits** Sample **UNDRAINED SHEAR STRENGTH (TSF)** % (blows/ft) WATER CONTENT **BORING NO. PERCENT** DENSITY Œ UNCONFINED **UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE | PENETRO-PRESSURE) **TEST** (%) METER DRY (TSF) (TSF) Sandy Lean Clay (CL) B-7 0-2 UD 12 4.50 1 2 UD 29 4.50 Sandy Lean Clay (CL) 2-4 11 15 14 68 4.50 Sandy Lean Clay (CL) 4-6 UD 3 12 4.50 Sandy Lean Clay (CL) 4 6-8 UD 12 122 2.25 5 8-10 UD 17 48 17 30 3.50 Sandy Lean Clay (CL) UD 2.50 Sandy Lean Clay (CL) 6 10-12 24 UD 4.50 Sandy Lean Clay (CL) B-8 1 0-2 12 44 18 26 69 2 UD 4.50 Sandy Lean Clay (CL) 2-4 11 UD 4.00 Sandy Lean Clay (CL) 3 4-6 8 112 1.60 UD 4.50 4 6-8 6 Sandy Lean Clay (CL) 5 8-10 UD 12 4.50 Sandy Lean Clay (CL) Sandy Fat Clay (CH) 6 UD 4.00 10-12 16 54 19 35 67 3.50 12-14 UD 28 Sandy Fat Clay (CH) B-9 0-2 UD 4.50 Sandy Lean Clay (CL) UD 4.50 Sandy Lean Clay (CL) 2 10 25 15 51 2-4 10 UD 3 4-6 11 4.50 Sandy Lean Clay (CL) 4 6-8 UD 8 115 2.25 4.50 Sandy Lean Clay (CL) 5 8-10 UD 10 4.50 Sandy Lean Clay (CL) 6 10-12 UD 11 4.50 Sandy Lean Clay (CL) 4.50 UD 25 22 Sandy Fat Clay (CH) 12-13 69 47 51

SPT - Standard Penetration Test

Legena:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab

Designates consolidation test Performed

AG - Auger Cutting in Field

SS - Split Spoon Sample

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 **CONSULTANT PROJECT NUMBER: G13-164** TEL: (713) 748-3717 FAX: (713) 748-3748 (bct) Sample **Atterberg Limits UNDRAINED SHEAR STRENGTH (TSF)** % (blows/ft) WATER CONTENT **BORING NO. PERCENT** DENSITY Œ UNCONFINED **UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE | PENETRO-PRESSURE) **TEST** SPT (%) METER DRY (TSF) (TSF) Sandy Lean Clay (CL) B-10 0-2 UD 19 3.50 2 UD 15 42 4.00 Sandy Lean Clay (CL) 2-4 18 24 63 Sandy Lean Clay (CL) 3.50 UD 3 4-6 15 4.00 4 6-8 UD 15 117 1.55 Sandy Lean Clay (CL) 5 8-10 UD 18 47 18 29 65 3.00 Sandy Lean Clay (CL) UD 21 2.50 Sandy Lean Clay (CL) 6 10-12 Sandy Lean Clay (CL) 7 12-13 UD 16 4.00 UD 4.50 Sandy Lean Clay (CL) B-11 1 0-2 12 37 17 20 67 UD 4.50 Sandy Lean Clay (CL) 2 11 2-4 UD 4.50 Sandy Lean Clay (CL) 3 4-6 11 Sandy Lean Clay (CL) 4 6-8 UD 12 123 2.25 4.50 5 UD 4.50 Sandy Lean Clay (CL) 8-10 12 38 17 21 0.85(0.58)6 10-12 UD 24 3.00 Sandy Lean Clay (CL) 100 UD 21 4.00 Sandy Lean Clay (CL) 12-13 UD 9 3.00 Sandy Lean Clay (CL) B-12 0-2 26 15 11 60 UD Sandy Lean Clay (CL) 2 2-4 6 3.50 Sandy Lean Clay (CL) 3 4-6 UD 12 4.50 4 6-8 UD 8 4.50 Sandy Lean Clay (CL)

Legena:

5

6

8-10

10-12

UD

UD

UD - Undisturbed Sample Extruded in Field

11

12

123

40

17

23

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

AG - Auger Cutting in Field SS - Split Spoon Sample

SPT - Standard Penetration Test

2.25

4.50

4.00

Sandy Lean Clay (CL)

Sandy Lean Clay (CL)

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 TEL: (713) 748-3717 FAX: (713) 748-3748 **CONSULTANT PROJECT NUMBER: G13-164 Atterberg Limits** Sample DENSITY (pcf) **UNDRAINED SHEAR STRENGTH (TSF)** % (blows/ft) WATER CONTENT **BORING NO. PERCENT** Œ UNCONFINED **UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE PENETRO-PRESSURE) **TEST** SPT (%) METER DRY (TSF) (TSF) Sandy Lean Clay (CL) B-13 0-2 UD 9 4.50 2 UD 27 55 4.50 Sandy Lean Clay (CL) 2-4 6 15 12 Sandy Lean Clay (CL) 4.00 4-6 UD 10 3 118 1.85 Sandy Lean Clay (CL) 4.50 4 6-8 UD 12 5 8-10 UD 11 4.50 Sandy Lean Clay (CL) UD 13 4.50 Sandy Lean Clay (CL) 6 10-12 38 17 21 70 Sandy Lean Clay (CL) 7 12-13 UD 11 3.25 UD 4.50 Sandy Lean Clay (CL) B-14 0-2 14 1 UD 4.50 Sandy Lean Clay (CL) 2 12 2-4 UD 4.50 Sandy Lean Clay (CL) 3 4-6 10 36 17 19 70 Sandy Lean Clay (CL) 4 6-8 UD 12 4.50

Legend:

B-15

5

6

2

3

4

5

6

8-10

10-12

12-14

0-2

2-4

4-6

6-8

8-10

10-12

12-14

UD - Undisturbed Sample Extruded in Field

18

15

12

12

12

15

17

17

17

16

120

122

45

34

52

18

16

19

27

18

33

UD

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

AG - Auger Cutting in Field

69

62

68

SS - Split Spoon Sample

SPT - Standard Penetration Test

2.25

1.55

2.00

2.00

4.50

3.00

3.50

2.00

2.00

3.50 4.00

4.00

Sandy Lean Clay (CL)

Sandy Lean Clay (CL)
Sandy Fat Clay (CH)

Sandy Fat Clay (CH)

Sandy Fat Clay (CH)

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN INNER LOOP AREA

COH WBS NO: S-000035-0180-3

CONSULTANT PROJECT NUMBER: G13-164

		( - /	7 +0 -07			٦٨. (١١٥	,	_		001100211	HINT PROJECT I	102 = 11 0			
	;	Sample	<del>)</del>	_	(%)	(pcf)	Atter	berg L	imits		UNDRAIN	ED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	<b>DEPTH (ft)</b>	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	TI II	PL	Ē	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-16	1	0-2	UD		11		32	16	16	69				4.50	Sandy Lean Clay (CL)
	2	2-4	UD		10									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		12									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		13									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		12		43	18	25					4.50	Sandy Lean Clay (CL)
	6	10-12	UD		15	118					1.90			4.00	Sandy Lean Clay (CL)
	7	12-14	UD		16									4.00	Sandy Lean Clay (CL)
B-17	1	0-2	UD		16		44	19	26	63				3.00	Sandy Lean Clay (CL)
	2	2-4	UD		16									2.50	Sandy Lean Clay (CL)
	3	4-6	UD		13									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		14	120					2.25			4.50	Sandy Lean Clay (CL)
	5	8-10	UD		15		54	19	35	69				3.50	Sandy Fat Clay (CH)
	6	10-12	UD		22									4.00	Sandy Fat Clay (CH)
	7	12-14	UD		20	108						0.83(0.65)		4.00	Sandy Fat Clay (CH)
B-18	1	0-2	UD		14		29	15	14	51				3.00	Sandy Lean Clay (CL)
	2	2-4	UD		14									3.00	Sandy Lean Clay (CL)
	3	4-6	UD		14									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		11		25	15	10					2.00	Sandy Lean Clay (CL)
	5	8-10	UD		12	120					0.80			4.00	Sandy Lean Clay (CL)
	6	10-12	SS	15	5										Silty Sand (SM)
	7	12-14	SS	20	5										Silty Sand (SM)
	8	14-16	SS	25	24					16					Silty Sand (SM)
	9	16-18	SS	23	24										Silty Sand (SM)

Legena:

UD - Undisturbed Sample Extruded in Field UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 TEL: (713) 748-3717 FAX: (713) 748-3748 **CONSULTANT PROJECT NUMBER: G13-164 Atterberg Limits UNDRAINED SHEAR STRENGTH (TSF)** Sample DENSITY (pcf) WATER CONTENT (%) (blows/ft) **BORING NO. PERCENT** Œ UNCONFINED **UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE PENETRO-PRESSURE) **TEST** (%) METER DRY (TSF) (TSF) 2.00 Sandy Lean Clay (CL) B-19 0-2 UD 17 40 17 23 52 2 UD 18 3.00 Sandy Lean Clay (CL) 2-4 Sandy Lean Clay (CL) 3.00 4-6 UD 15 3 Sandy Lean Clay (CL) 3.00 4 6-8 UD 15 45 18 27 Sandy Lean Clay (CL) 5 8-10 UD 14 121 2.25 4.50 SS Silty Sand (SM) 6 10-12 22 8 12-13.5 SS 21 7 23 Silty Sand (SM) UD 15 1.00 Sandy Lean Clay (CL) B-20 0-2 1 UD 2.50 Sandy Lean Clay (CL) 2 16 17 2-4 38 21 51 UD 3.00 Sandy Lean Clay (CL) 3 4-6 16 Sandy Lean Clay (CL) 4 6-8 UD 14 3.75 5 UD 17 4.25 Sandy Lean Clay (CL) 8-10 113 1.90 2.00 Sandy Lean Clay (CL) 6 10-12 UD 17 15 31 16 SS 9 Silty Sand (SM) 2-13.5 14 UD 21 Lean Clay (CL) B-21 0-2 49 19 30 90 4.00 UD 22 3.00 Lean Clay (CL) 2 2-4 Lean Clay (CL) 3 4-6 UD 20 3.50 4 6-8 UD 17 4.00 Lean Clay (CL) Lean Clay (CL)

\_egend:

5

6

8-10

10-12

12-14

UD

UD

UD

UD - Undisturbed Sample Extruded in Field

27

18

17

114

29

15

14

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

AG - Auger Cutting in Field

SS - Split Spoon Sample

SPT - Standard Penetration Test

0.75

2.50

2.00

3.00

Lean Clay (CL)

Lean Clay (CL)

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

CONSULTANT PROJECT NUMBER: G13-164

	(	Sample	,		I	<del></del>		berg L	imits		UNDRAIN	IED SHEAR S	(TSF)	
BORING NO.	NO.	DEPTH (ft)	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	11	P.	Б	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST	POCKET PENETRO- METER	TYPE OF MATERIAL
B-22	1	0-2	UD		17								3.50	Sandy Fat Clay (CH)
	2	2-4	UD		17								2.50	Sandy Fat Clay (CH)
	3	4-6	UD		18		50	19	31	70			3.00	Sandy Fat Clay (CH)
	4	6-8	UD		40								1.75	Sandy Fat Clay (CH)
	5	8-10	UD		29								1.00	Sandy Fat Clay (CH)
	6	10-12	UD		20		37	17	20				1.75	Sandy Lean Clay (CL)
	7	12-13	UD		16	116					0.75		2.00	Sandy Lean Clay (CL)
B-23	1	0-2	UD		18		45	18	27	67			3.00	Sandy Lean Clay (CL)
	2	2-4	UD		17								4.00	Sandy Lean Clay (CL)
	3	4-6	UD		17								3.00	Sandy Lean Clay (CL)
	4	6-8	UD		18		61	21	40				3.50	Fat Clay with Sand (CH)
	5	8-10	UD		25	97	64	21	43		0.80		2.00	Fat Clay with Sand (CH)
	6	10-12	UD		18		49	19	30	70			3.00	Sandy Lean Clay (CL)
	7	12-14	UD		20								4.50	Sandy Lean Clay (CL)
	8	14-15	UD		21	109						1.39(0.72)	4.50	Sandy Lean Clay (CL)
B-24	1	0-2	UD		12								4.00	Sandy Lean Clay (CL)
	2	2-4	UD		16		35	16	19	70			3.50	Sandy Lean Clay (CL)
	3	4-6	UD		17								3.00	Sandy Lean Clay (CL)
	4	6-8	UD		19								3.00	Sandy Lean Clay (CL)
	5	8-10	UD		16	111					0.65		2.00	Sandy Lean Clay (CL)
	6	10-12	UD		26		74	23	51				2.00	Fat Clay with Sand (CH)

Legena:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

### ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

**CONSULTANT PROJECT NUMBER: G13-164** 

BORING NO.	<b>DEPTH (ft)</b>	эE	(blows/ft)	ENT (	(pcf)			1						
BC	DE	TYPE	SPT (blo	WATER CONTENT (%)	DRY DENSITY	רר	PL	Ā	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-25 1	0-2	UD		15									4.50	Sandy Lean Clay (CL)
2	2-4	UD		15		47	18	29	69				4.50	Sandy Lean Clay (CL)
3	4-6	UD		11									4.50	Sandy Lean Clay (CL)
4	6-8	UD		13									4.50	Sandy Lean Clay (CL)
5	8-10	UD		12		42	18	24	67				4.50	Sandy Lean Clay (CL)
6	10-12	UD		15	118					1.70			4.00	Sandy Lean Clay (CL)
7	12-14	UD		15	122						4.46(0.65)		4.50	Sandy Lean Clay (CL)
B-26 1	0-2	UD		21									2.00	Fat Clay with Sand (CH)
2	2-4	UD		21		51	19	32	79				2.00	Fat Clay with Sand (CH)
3	4-6	UD		20									2.50	Fat Clay with Sand (CH)
4	6-8	UD		19									2.50	Fat Clay with Sand (CH)
5	8-10	UD		20	113	46	18	28		1.55			4.00	Lean Clay with Sand (CL)
6	10-12	UD		17		39	17	22	81				3.50	Lean Clay with Sand (CL)
7	12-14	UD		17									4.00	Lean Clay with Sand (CL)
B-27 1	0-2	UD		10		23	15	8	51				4.00	Sandy Lean Clay (CL)
2	2-4	UD		10									4.00	Sandy Lean Clay (CL)
3	4-6	UD		8	118					2.25			4.50	Sandy Lean Clay (CL)
4	6-8	UD		9									4.50	Sandy Lean Clay (CL)
5	8-10	UD		11		35	16	19					4.50	Sandy Lean Clay (CL)
6	10-12	UD		17									1.75	Sandy Lean Clay (CL)

Legena:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

AG - Auger Cutting in Field SS - Split Spoon Sample SPT - Standard Penetration Test

**STING LABORATORIES, INC.** 

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 **CONSULTANT PROJECT NUMBER: G13-164** TEL: (713) 748-3717 FAX: (713) 748-3748

		Sample	)		(%)	(pcf)	Atter	berg L	imits		UNDRAIN	ED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	<b>DEPTH (ft)</b>	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	ור	PL	۵	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-28	1	0-2	UD		16		26	15	11	51				2.00	Sandy Lean Clay (CL)
	2	2-4	UD		17									2.75	Sandy Lean Clay (CL)
	3	4-6	UD		14									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		14									3.50	Sandy Lean Clay (CL)
	5	8-10	UD		16	117					1.15			3.50	Sandy Lean Clay (CL)
	6	10-12	UD		18		51	19	32					3.50	Fat Clay with Sand (CH)
	7	12-13	UD		27									3.00	Fat Clay with Sand (CH)
B-29	1	0-2	UD		16		35	16	19	70				2.50	Sandy Lean Clay (CL)
	2	2-4	UD		15									2.75	Sandy Lean Clay (CL)
	3	4-6	UD		16									2.00	Sandy Lean Clay (CL)
	4	6-8	UD		17									1.50	Sandy Lean Clay (CL)
	5	8-10	UD		17		44	18	26					2.50	Sandy Lean Clay (CL)
	6	10-12	UD		17	114					1.25			3.50	Sandy Lean Clay (CL)
B-30	1	0-2	UD		13		44	18	26	67				4.00	Sandy Lean Clay (CL)
	2	2-4	UD		15									3.50	Sandy Lean Clay (CL)
	3	4-6	UD		15									4.00	Sandy Lean Clay (CL)
	4	6-8	UD		16									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		20	110					1.05			3.50	Sandy Lean Clay (CL)
	6	10-12	UD		27		48	18	30					3.50	Sandy Lean Clay (CL)
	7	12-14	UD		17	116						1.63 (0.65)		4.00	Sandy Lean Clay (CL)
	8	14-15	UD		18									3.50	Sandy Lean Clay (CL)

Legend:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 TEL: (713) 748-3717 FAX: (713) 748-3748 **CONSULTANT PROJECT NUMBER: G13-164** Sample DENSITY (pcf) **Atterberg Limits UNDRAINED SHEAR STRENGTH (TSF)** % (blows/ft) WATER CONTENT **BORING NO. PERCENT** Œ **UNCONFINED UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE | PENETRO-PRESSURE) **TEST** SPT (%) METER DRY (TSF) (TSF) Fat Clay with Sand (CH) B-31 0-2 UD 19 2.00 1 2 UD 18 54 73 2.50 Fat Clay with Sand (CH) 2-4 19 35 Fat Clay with Sand (CH) 3.00 4-6 UD 3 16 Fat Clay with Sand (CH) 3.50 4 6-8 UD 16 5 8-10 UD 21 4.00 Fat Clay with Sand (CH) UD 21 2.00 Fat Clay with Sand (CH) 6 10-12 108 0.85 7 12-14 UD 17 43 18 25 3.50 Sandy Lean Clay (CL) 69 Sandy Lean Clay (CL) 6 UD 18 4.00 14-15 UD 20 1.50 Sandy Lean Clay (CL) B-32 0-2 46 18 28 70 UD 3.00 Sandy Lean Clay (CL) 2 2-4 18 Sandy Lean Clay (CL) 3 4-6 UD 17 3.50 4 UD 18 52 3.00 Sandy Fat Clay (CH) 6-8 19 33 69 2.00 8-10 UD 32 95 0.75 Sandy Fat Clay (CH) 5

Legend:

B-33

6

2

3

4

5

6

10-12

0-2

2-4

4-6

6-8

8-10

10-12 12-14

UD - Undisturbed Sample Extruded in Field

27

12

16

15

16

13

15

17

99

121

37

50

17

19

20

31

UD

UD

UD

UD

UD

UD

UD

UD

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

AG - Auger Cutting in Field

70

85

SS - Split Spoon Sample

SPT - Standard Penetration Test

1.90

0.82(0.58)

3.00

4.00

3.50

3.00

3.50

4.00 3.50

4.00

Sandy Fat Clay (CH)

Sandy Lean Clay (CL)

Sandy Lean Clay (CL)

Sandy Lean Clay (CL)

Sandy Lean Clay (CL) Sandy Lean Clay (CL)

Sandy Lean Clay (CL)

Fat Clay with Sand (CH)

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

CONSULTANT PROJECT NUMBER: G13-164

		Sample	)	_	(%)	cf)	Atter	berg L	imits		UNDRAIN	ED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	<b>DEPTH (ft)</b>	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	וו	PL	ā	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-34	1	0-2	UD		10		26	15	11	57				3.50	Sandy Lean Clay (CL)
	2	2-4	UD		9									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		8									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		10									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		10	117					2.25			4.50	Sandy Lean Clay (CL)
	6	10-12	UD		19		53	19	34	85				4.50	Fat Clay with Sand (CH)
	7	12-14	UD		19									4.00	Fat Clay with Sand (CH)
B-35	1	0-2	UD		24		68	22	46	71				0.50	Fat Clay with Sand (CH)
	2	2-4	UD		19									2.00	Fat Clay with Sand (CH)
	3	4-6	UD		17									3.00	Fat Clay with Sand (CH)
	4	6-8	UD		24									3.00	Fat Clay with Sand (CH)
	5	8-10	UD		25	98					0.60			2.00	Fat Clay with Sand (CH)
	6	10-12	UD		20		62	21	41	80				3.50	Fat Clay with Sand (CH)
	7	12-14	UD		19									3.00	Fat Clay with Sand (CH)
B-36	1	0-2	UD		14		35	16	19	69				4.00	Sandy Lean Clay (CL)
	2	2-4	UD		9									4.00	Sandy Lean Clay (CL)
	3	4-6	UD		11									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		13									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		13	118					1.70			4.00	Sandy Lean Clay (CL)
	6	10-12	UD		16									3.50	Sandy Lean Clay (CL)
	7	12-14	UD		15	120						2.08(0.65)		4.00	Sandy Lean Clay (CL)
	8	14-15	UD		16		45	18	27	70				4.00	Sandy Lean Clay (CL)

Legend:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

**CONSULTANT PROJECT NUMBER: G13-164** 

		Sample	)	_	(%)	(bct)	Atter	berg L	imits.		UNDRAIN	IED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	<b>DEPTH (ft)</b>	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	TI II	PL	Ē	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-37	1	0-2	UD		23		57	20	37	82				1.50	Fat Clay with Sand (CH)
	2	2-4	UD		22									2.00	Fat Clay with Sand (CH)
	3	4-6	UD		26									2.00	Fat Clay with Sand (CH)
	4	6-8	UD		22		59	20	39					2.50	Fat Clay with Sand (CH)
	5	8-10	UD		20									3.00	Fat Clay with Sand (CH)
	6	10-12	UD		22	99					0.50			2.00	Fat Clay with Sand (CH)
	7	12-14	UD		17		43	18	25	70				3.50	Sandy Lean Clay (CL)
	8	14-15	UD		16									4.00	Sandy Lean Clay (CL)
B-38	1	0-2	UD		11		36	17	19	68				4.50	Sandy Lean Clay (CL)
	2	2-4	UD		9									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		12	117					2.25			4.50	Sandy Lean Clay (CL)
	4	6-8	UD		15									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		20		67	21	46					3.50	Fat Clay with Sand (CH)
	6	10-12	UD		15									3.00	Fat Clay with Sand (CH)
	7	12-13	UD		13									4.00	Fat Clay with Sand (CH)
B-39	1	0-2	UD		9									4.50	Sandy Lean Clay (CL)
	2	2-4	UD		6		37	17	20	60				4.50	Sandy Lean Clay (CL)
	3	4-6	UD		10									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		9									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		15		65	21	44	85				4.50	Fat Clay with Sand (CH)
	6	10-12	UD		16	109					2.25			4.50	Fat Clay with Sand (CH)
	7	12-14	UD		13									4.50	Fat Clay with Sand (CH)

Legend:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

CONSULTANT PROJECT NUMBER: G13-164

		Sample	Э		(%	(bct)	Atter	berg L	imits		UNDRAIN	IED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	DEPTH (ft)	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	11	PL	₫	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-40	1	0-2	UD		15									4.50	Sandy Lean Clay (CL)
	2	2-4	UD		11									4.50	Sandy Lean Clay (CL)
	3	4-6	UD		10		35	16	19	51				4.50	Sandy Lean Clay (CL)
	4	6-8	UD		13									4.00	Sandy Lean Clay (CL)
	5	8-10	UD		12									4.00	Sandy Lean Clay (CL)
	6	10-12	UD		10	113					1.15			3.50	Sandy Lean Clay (CL)
	7	12-14	UD		13		33	16	17					2.50	Sandy Lean Clay (CL)
B-41	1	0-2	UD		11									4.50	Sandy Lean Clay (CL)
	2	2-4	UD		13		35	16	19	51				3.00	Sandy Lean Clay (CL)
	3	4-6	UD		14									3.50	Sandy Lean Clay (CL)
	4	6-8	UD		14	116					0.85			2.00	Sandy Lean Clay (CL)
	5	8-10	UD		15									2.00	Sandy Lean Clay (CL)
	6	10-12	UD		14									2.75	Sandy Lean Clay (CL)
	7	12-13	UD		15		35	16	19	69				3.50	Sandy Lean Clay (CL)
B-42	1	0-2	UD		17									4.50	Sandy Lean Clay (CL)
	2	2-4	UD		17									4.40	Sandy Lean Clay (CL)
	3	4-6	UD		16		33	17	16	55				4.50	Sandy Lean Clay (CL)
	4	6-8	UD		17									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		17	114					2.15			4.50	Sandy Lean Clay (CL)
	6	10-12	UD		17									3.50	Sandy Lean Clay (CL)
	7	12-13	UD		16		27	15	12	51				4.00	Sandy Lean Clay (CL)

Legena:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 **CONSULTANT PROJECT NUMBER: G13-164** TEL: (713) 748-3717 FAX: (713) 748-3748 (bct) Sample **Atterberg Limits UNDRAINED SHEAR STRENGTH (TSF)** % (blows/ft) WATER CONTENT **BORING NO. PERCENT** DENSITY Œ UNCONFINED **UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE | PENETRO-PRESSURE) **TEST** SPT (%) METER DRY (TSF) (TSF) Sandy Lean Clay (CL) B-43 0-2 UD 12 4.50 2 UD 10 35 4.50 Sandy Lean Clay (CL) 2-4 16 19 61 Sandy Lean Clay (CL) 1.95 4.50 UD 3 4-6 11 123 4.00 4 6-8 UD 12 Sandy Lean Clay (CL) 5 8-10 UD 13 3.50 Sandy Lean Clay (CL) UD 17 0.85(0.58)2.00 Sandy Lean Clay (CL) 6 10-12 108 Sandy Lean Clay (CL) 7 12-13 UD 18 39 17 22 70 2.00 UD 70 3.50 Sandy Lean Clay (CL) B-44 1 0-2 14 35 16 19 UD 0.50 Sandy Lean Clay (CL) 2 18 2-4 UD 17 3.50 Sandy Lean Clay (CL) 3 4-6 Sandy Lean Clay (CL) 4 6-8 UD 18 3.00 5 UD 35 1.50 Fat Clay with Sand (CH) 8-10 77 23 54 2.00 Fat Clay with Sand (CH) 6 10-12 UD 25 104 0.85 B-45 0-2 UD 11 4.50 Sandy Lean Clay (CL) UD Sandy Lean Clay (CL) 2 8 32 16 4.50 2-4 16 68 UD Sandy Lean Clay (CL) 3 4-6 10 4.50 4 6-8 UD 14 4.50 Sandy Lean Clay (CL) 5 8-10 UD 15 18 4.50 Sandy Lean Clay (CL) 49 30 56 6 10-12 UD 19 108 0.70 2.00 Sandy Lean Clay (CL) 3.50 Sandy Lean Clay (CL)

Legena:

UD - Undisturbed Sample Extruded in Field

19

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

UD

12-13

AG - Auger Cutting in Field SS - Split Spoon Sample

SPT - Standard Penetration Test

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

**CONSULTANT PROJECT NUMBER: G13-164** 

	,	Sample	)		(%)	(bct)	Atter	berg L	imits		UNDRAIN	IED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	<b>DEPTH (ft)</b>	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	11	PL	Ы	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-46	1	0-2	UD		17									2.50	Fat Clay with Sand (CH)
	2	2-4	UD		15									4.00	Fat Clay with Sand (CH)
	3	4-6	UD		21		56	20	36	75				1.00	Fat Clay with Sand (CH)
	4	6-8	UD		29									3.00	Fat Clay with Sand (CH)
	5	8-10	UD		20	109					1.35			3.50	Fat Clay with Sand (CH)
	6	10-12	UD		16									3.00	Fat Clay with Sand (CH)
	7	12-14	UD		19									4.00	Fat Clay with Sand (CH)
	8	14-15	UD		21		66	21	45	85				4.00	Fat Clay with Sand (CH)
B-47	1	0-2	UD		12									4.50	Sandy Lean Clay (CL)
	2	2-4	UD		13		45	18	27	69				4.50	Sandy Lean Clay (CL)
	3	4-6	UD		15									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		16									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		26									3.00	Sandy Lean Clay (CL)
	6	10-12	UD		15	114					1.85			4.00	Sandy Lean Clay (CL)
	7	12-14	UD		15		39	17	22					3.50	Sandy Lean Clay (CL)
	8	14-16	UD		13									4.00	Sandy Lean Clay (CL)
B-48	1	0-2	UD		15									3.00	Sandy Lean Clay (CL)
	2	2-4	UD		14		31	16	15	70				2.50	Sandy Lean Clay (CL)
	3	4-6	UD		13									4.00	Sandy Lean Clay (CL)
	4	6-8	UD		16									2.50	Sandy Lean Clay (CL)
	5	8-10	UD		20		56	20	36					3.00	Fat Clay with Sand (CH)
	6	10-12	UD		27	98					0.90			2.25	Fat Clay with Sand (CH)

Legend:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

### ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

**CONSULTANT PROJECT NUMBER: G13-164** 

	,	Sample	)		(%)	cf)	Atter	berg L	imits		UNDRAIN	ED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	<b>DEPTH (ft)</b>	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (pcf)	11	PL	Ы	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-49	1	0-2	UD		17		35	16	19	70				2.75	Sandy Lean Clay (CL)
	2	2-4	UD		18									2.50	Sandy Lean Clay (CL)
	3	4-6	UD		16									3.75	Sandy Lean Clay (CL)
	4	6-8	UD		14									3.50	Sandy Lean Clay (CL)
	5	8-10	UD		17		43	18	25	70				3.75	Sandy Lean Clay (CL)
	6	10-12	UD		19									2.50	Sandy Lean Clay (CL)
	7	12-14	UD		17	114					1.00			3.50	Sandy Lean Clay (CL)
	7	14-16	UD		16		44	18	26					4.00	Sandy Lean Clay (CL)
	8	16-17	UD		15									4.00	Sandy Lean Clay (CL)
B-50	1	0-2	UD		10		36	17	19	69				4.50	Sandy Lean Clay (CL) fill
	2	2-4	UD		9									4.50	Sandy Lean Clay (CL) fill
	3	4-6	UD		11		40	17	23					4.50	Sandy Lean Clay (CL)
	4	6-8	UD		13									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		13	109					1.75			4.00	Sandy Lean Clay (CL)
	6	10-12	UD		11		42	18	24	68				4.50	Sandy Lean Clay (CL)
	7	12-14	UD		10									4.50	Sandy Lean Clay (CL)
	8	14-16	UD		10	127						5.19(0.72)		4.50	Sandy Lean Clay (CL)
	9	16-17	UD		17									4.50	Sandy Lean Clay (CL)
B-51	1	0-2	UD		16									2.00	Sandy Lean Clay (CL) Fill
	2	2-4	UD		16		25	15	10	63				1.00	Sandy Lean Clay (CL) Fill
	3	4-6	UD		19									1.00	Sandy Lean Clay (CL)
	4	6-8	UD		14									3.50	Sandy Lean Clay (CL)
	5	8-10	UD		17									3.50	Sandy Lean Clay (CL)
	6	10-12	UD		15	115					0.40			1.25	Sandy Lean Clay (CL)
	7	12-13	UD		17		24	15	9	62				1.50	Sandy Lean Clay (CL)
	8	16-18	UD		13		37	17	20					4.50	Sandy Lean Clay (CL)

Legena:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

### ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

**CONSULTANT PROJECT NUMBER: G13-164** 

		Sample	)	_	(%)	(bct)	Atter	berg L	imits		UNDRAIN	IED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO.	DEPTH (ft)	TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	11	PL	Ы	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-52	1	0-2	UD		6									3.50	Sandy Lean Clay (CL)
	2	2-4	UD		9		33	16	17	61				4.50	Sandy Lean Clay (CL)
	3	4-6	UD		10									4.50	Sandy Lean Clay (CL)
	4	6-8	UD		12									4.50	Sandy Lean Clay (CL)
	5	8-10	UD		11	116					1.35			3.50	Sandy Lean Clay (CL)
	6	10-12	UD		11		36	17	19					4.50	Sandy Lean Clay (CL)
	7	12-13	UD		13									4.50	Sandy Lean Clay (CL)
B-53	1	0-2	UD		5		19	14	5	45				2.50	Clayey Silt (CL-ML)
	2	2-4	UD		13									1.50	Sandy Lean Clay (CL)
	3	4-6	UD		16									2.00	Sandy Lean Clay (CL)
	4	6-8	UD		17									2.00	Sandy Lean Clay (CL)
	5	8-10	UD		18		32	16	16					1.00	Sandy Lean Clay (CL)
	6	10-12	UD		14	111					0.45			1.25	Sandy Lean Clay (CL)
	7	12-14	SS	19	15										Silty Sand (SM)
	8	14-16	UD		17									1.00	Sandy Lean Clay (CL)
	9	16-18	UD		17		51	19	32	85				4.00	Fat Clay with Sand (CH)
	10	18-19	UD		16	117					1.75			4.00	Fat Clay with Sand (CH)
B-54	1	0-2	UD		13		38	17	21	60				4.00	Sandy Lean Clay (CL)
	2	2-4	UD		13									3.50	Sandy Lean Clay (CL)
	3	4-6	UD		14									3.00	Sandy Lean Clay (CL)
	4	6-8	UD		14									2.00	Sandy Lean Clay (CL)
	5	8-10	UD		15	114	33	16	17		0.70			2.00	Sandy Lean Clay (CL)
	6	10-12	UD		12									2.00	Sandy Lean Clay (CL)
	7	12-14	UD		13									2.00	Sandy Lean Clay (CL)

Legena:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

## ASSOCIATED TESTING LABORATORIES, INC.

3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052

TEL: (713) 748-3717

FAX: (713) 748-3748

#### PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA

COH WBS NO: S-000035-0180-3

**CONSULTANT PROJECT NUMBER: G13-164** 

	,	Sample	)		(%)	(bct)	Atter	berg L	imits		UNDRAIN	IED SHEAR S	TRENGTH	(TSF)	
BORING NO.	NO. DEPTH (ft)		TYPE	SPT (blows/ft)	WATER CONTENT (%)	DRY DENSITY (p	וו	PL	Ē	PERCENT PASSING SIEVE 200 (%)	UNCONFINED COMPRESSION TEST (TSF)	UU TEST ( CONFINING PRESSURE ) ( TSF )	TORVANE	POCKET PENETRO- METER	TYPE OF MATERIAL
B-55	1	0-2	UD		14									3.00	Sandy Lean Clay (CL)
	2	2-4	UD		13		30	16	14	52				3.75	Sandy Lean Clay (CL)
	3	4-6	UD		15									3.00	Sandy Lean Clay (CL)
	4	6-8	UD		18									2.00	Sandy Lean Clay (CL)
	5	8-10	UD		19									1.50	Sandy Lean Clay (CL)
	6	10-12	UD		16		43	18	25					2.50	Sandy Lean Clay (CL)
	7	12-14	UD		16	116					1.70			4.00	Sandy Lean Clay (CL)
B-56	1	0-2	UD		23		56	20	36	72				1.50	Fat Clay with Sand (CH)
	2	2-4	UD		24									1.75	Fat Clay with Sand (CH)
	3	4-6	UD		17		50	19	31					2.50	Fat Clay with Sand (CH)
	4	6-8	UD		18									2.75	Fat Clay with Sand (CH)
	5	8-10	UD		24	98	60	20	40		0.60			2.00	Fat Clay with Sand (CH)
	6	10-12	UD		20		39	17	22	70				2.00	Sandy Lean Clay (CL)
	7	12-14	UD		17	114						1.07(0.65)		3.00	Sandy Lean Clay (CL)
	8	14-15	UD		19		30	16	14					2.75	Sandy Lean Clay (CL)
B-57	1	0-2	UD		12									3.50	Sandy Lean Clay (CL)
	2	2-4	UD		10		30	16	14	59				4.00	Sandy Lean Clay (CL)
	3	4-6	UD		12									3.00	Sandy Lean Clay (CL)
	4	6-8	UD		20									2.75	Sandy Lean Clay (CL)
	5	8-10	UD		13	116					1.20			3.50	Sandy Lean Clay (CL)
		10-12	UD		14		43	18	25					3.00	Sandy Lean Clay (CL)
	6	12-14	UD		13	122						2.68(0.65)		4.50	Sandy Lean Clay (CL)

Legend:

UD - Undisturbed Sample Extruded in Field

UL - Undisturbed Sample Extruded in Lab Designates consolidation test Performed

#### ASSOCIATED TESTING LABORATORIES, INC. PROJECT NAME: WATER LINE REPLACEMENT IN HAMMERLY AREA 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS 77052 COH WBS NO: S-000035-0180-3 **CONSULTANT PROJECT NUMBER: G13-164** TEL: (713) 748-3717 FAX: (713) 748-3748 **Atterberg Limits** Sample DENSITY (pcf) **UNDRAINED SHEAR STRENGTH (TSF)** WATER CONTENT (%) (blows/ft) **BORING NO. PERCENT** Ħ UNCONFINED **UU TEST PASSING POCKET** TYPE **TYPE OF MATERIAL** DEPTH ( COMPRESSION (CONFINING Š SIEVE 200 占 TORVANE | PENETRO-PRESSURE) **TEST** SPT (%) **METER** DRY (TSF) (TSF) 2.50 Sandy Lean Clay (CL) B-58 0-2 UD 12 2 UD 32 3.50 Sandy Lean Clay (CL) 2-4 11 16 16 65 Sandy Lean Clay (CL) 4.50 4-6 UD 3 14 Sandy Lean Clay (CL) 4.50 4 6-8 UD 13 5 8-10 UD 20 3.00 Sandy Lean Clay (CL) UD 2.50 Sandy Lean Clay (CL) 6 10-12 13 42 18 24 Sandy Lean Clay (CL) 12-13 UD 14 114 1.45 3.50 UD 4.50 Sandy Lean Clay (CL) B-59 0-2 11 1 UD 4.50 Sandy Lean Clay (CL) 2 9 37 17 70 2-4 20 UD 4.50 3 4-6 12 Sandy Lean Clay (CL) Sandy Lean Clay (CL) 4 6-8 UD 14 4.50 5 UD 21 4.50 Sandy Lean Clay (CL) 8-10 113 2.20 4.00 Sandy Lean Clay (CL) 6 10-12 UD 14 113 1.75 38 17 21 61 12-14 UD 4.00 Sandy Lean Clay (CL) 11 UD 1.60(0.72) 3.50 8 14-16 14 118 Sandy Lean Clay (CL) Legena: AG - Auger Cutting in Field UD - Undisturbed Sample Extruded in Field SS - Split Spoon Sample UL - Undisturbed Sample Extruded in Lab SPT - Standard Penetration Test

Designates consolidation test Performed

## TABLE 4.1 Marston Soil Coefficients (C<sub>d</sub>) for Trench Conduits

 $A = K \mu' = \cdot 1924$  Granular materials without cohesion

 $D = K\mu' = \cdot 130$  Ordinary maximum for clay

 $B = K\mu^{\dagger} = \bullet$  165 Maximum for sand and gravel

 $\mathbf{E} = \mathbf{K} \mu' = \mathbf{\cdot} 110$  Maximum for saturated clay

 $C = K\mu^{\dagger} = \bullet$  150 Maximum for saturated top soil

H/B <sub>d</sub>	А	В	С	D	E
0.05	0.050	0.050	0.050	0.050	0.050
0.10	0.098	0.098	0.099	0.099	0.099
0.15	0.146	0.146	0.147	0.147	0.148
0.20	0.192	0.194	0.194	0.195	0.196
0.25	0.238	0.240	0.241	0.242	0.243
0.30	0.283	0.286	0.287	0.289	0.290
0.35	0.327	0.331	0.332	0.335	0.337
0.40	0.371	0.375	0.377	0.380	0.383
0.45	0.413	.0.418	0.421	0.425	0.428
0.50	0.455	0.461	0.464	0.469	0.473
0.55	0.496	0.503	0.507	0.512	0.518
0.60	0.536	0.544	0.549	0.555	0.562
0.65	0.575	0.585	0.591	0.598	0.606
0.70	0.614	0.625	0.631	0.640	0.649
0.75	0.651	0.664	0.672	0.681	0.691
0.80	0.689	0.703	0.711	0.722	0.734
0.85	0.725	0.741	0.750	0.763	0.775
0.90	0.761	0.779	0.789	0.802	0.817
0.95	0.796	0.816	0.827	0.842	0.857

H <sub>/Bd</sub>	А	В	С	D	Е
3.00	1.780	1.904	1.978	2.083	2.196
3.10	1.810	1.941	2.018	2.128	2.247
3.20	1.840	1.976	2.057	2.172	2.297
3.30	1.869	2.010	2.095	2.215	2.346
3.40	1.896	2.044	2.131	2.257	2.394
3.50	1.923	2.076	2.167	2.298	2.441
3.60	1.948	2.107	2.201	2.338	2.487
3.70	1.973	2.137	2.235	2.376	2.531
3.80	1.997	2.166	2.267	2.414	2.575
3.90	2.019	2.194	2.299	2.451	2.618
4.00	2.041	2.221	2.329	2.487	2.660
4.10	2.062	2.247	2.359	2.522	2.701
4.20	2.082	2.273	2.388	2.556	2.741
4.30	2.102	2.297	2.416	2.589	2.780
4.40	2.121	2.321	2.443	2.621	2.819
4.50	2.139	2.344	2.469	2.652	2.856
4.60	2.156	2.366	2.495	2.683	2.893
4.70	2.173	2.388	2.520	2.713	2.929
4.80	2.189	2.409	2.543	2.742	2.964

Source: American Water Works Association, Manual of Water Supply Practices, "Concrete Pressure Pipe, AMMA M9

MARSTON SOIL COEFFICIENTS (C <sub>d</sub> )
FOR TRENCH CONDUITS

ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748

WATER LINE REPLACEMENT IN HAMMERLY AREA

WBS NO. S-00035-0180-3

PROJECT NO. : G13-164

TABLE 4 (1 of 2)

TABLE 4.1 (cont)

H/B <sub>d</sub>	A	В	С	D	E
1.00	0.830	0.852	0.864	0.881	0.898
1.05	0.864	0.887	0.901	0.919	0.938
1.10	0.897	0.922	0.937	0.957	0.977
1.15	0.929	0.957	0.973	0.994	1.016
1.20	0.961	0.991	1.008	1.031	1.055
1.25	0.992	1.024	1.042	1.067	1.093
1.30	1.023	1.057	1.076	1.103	1.131
1.35	1.053	1.089	1.110	1.139	1.168
1.40	1.082	1.121	1.143	1.173	1.205
1.45	1.111	1.152	1.176	1.208	1.241
1.50	1.140	1.183	1.208	1.242	1.278
1.55	1.167	1.213	1.240	1.276	1.313
1.60	1.195	1.243	1.271	1.309	1.349
1.65	1.221	1.272	1.301	1.342	1.384
1.70	1.248	1.301	1.332	1.374	1.418
1.75	1.273	1.329	1.361	1.406	1.452
1.80	1.299	1.357	1.391	1.437	1.486
1.85	1.323	1.385	1.420	1.469	1.520
1.90	1.348	1.412	1.448	1.499	1.553
1.95	1.372	1.438	1.476	1.530	1.586
2.00	1.395	1.464	1.504	1.560	1.618
2.10	1.440	1.515	1.558	1.618	1.682
2.20	1.484	1.564	1.610	1.675	1.744
2.30	1.526	1.612	1.661	1.731	1.805
2.40	1.567	1.658	1.711	1.785	1.865
2.50	1.606	1.702	1.759	1.838	1.923
2.60	1.643	1.745	1.805	1.890	1.980
2.70	1.679	1.787	1.850	1.940	2.036
2.80	1.714	1.827	1.894	1.989	2.090
2.90	1.747	1.867	1.937	2.037	2.144

		,			
H <sub>/Bd</sub>	Α	В	С	D	E
4.90	2.204	2.429	2.567	2.770	2.999
5.00	2.219	2.448	2.590	2.798	3.032
5.10	2.234	2.467	2.612	2.825	3.065
5.20	2.247	2.486	2.633	2.851	3.098
5.30	2.261	2.503	2.654	2.877	3.129
5.40	2.273	2.520	2.674	2.901	3.160
5.50	2.286	2.537	2.693	2.926	3.190
5.60	2.298	2.553	2.712	2.949	3.220
5.70	2.309	2.568	2.730	2.972	3.248
5.80	2.320	2.583	2.748	2.995	3.277
5.90	2.330	2.598	2.766	3.017	3.304
6.00	2.340	2.612	2.782	3.038	3.331
6.20	2.360	2.639	2.814	3.079	3.383
6.40	2.377	2.664	2.845	3.118	3.433
6.60	2.394	2.687	2.873	3.155	3.481
6.80	2.409	2.709	2.900	3.190	3.527
7.00	2.423	2.730	2.925	3.223	3.571
7.20	2.436	2.749	2.949	3.255	3.613
7.40	2.448	2.767	2.971	3.285	3.653
7.60	2.459	2.784	2.992	3.313	3.691
7.80	2.470	2.799	3.012	3.340	3.728
8.00	2.479	2.814	3.031	3.366	3.763
8.50	2.500	2.847	3.073	3.424	3.845
9.00	2.517	2.875	3.109	3,476	3.918
9.50	2.532	2.898	3.141	3.521	3.983
10.0	2.543	2.919	3.167	3.560	4.042
15.0	2.591	3.009	3.296	3.768	4.378
20.0	2.598	3.026	3.325	3.825	4.490
30.0	2.599	3.030	3.333	3.845	4.539
40.0	2.599	3.030	3.333	3.846	4.545

MARSTON SOIL COEFFICIENTS  $(C_d)$ FOR TRENCH CONDUITS ASSOCIATED TESTING LABAORATORIES, INC. 3143 YELLOWSTONE BLVD., HOUSTON, TEXAS TEL: (713) 748-3717 Fax: (713) 748-3748

WATER LINE REPLACEMENT IN HAMMERLY AREA

WBS No. S-00035-0180-3

PROJECT NO.: G13-164

TABLE 4 (2 of 2)

## APPENDIX 1 PHOTOGRAPHS OF THE PROJECT SITE



Looking E along Emnora Ln, from Gessner Dr



Looking E along Hammerly Blvd, from Gessner Dr



Looking E along Springwood Forest Dr, from Gessner Dr



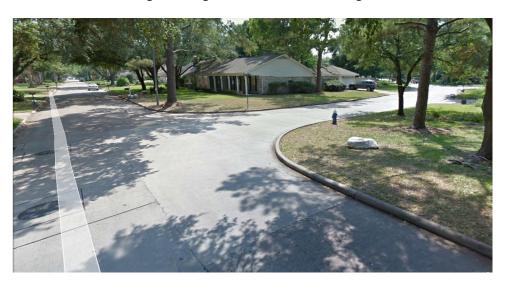
Looking W along Knoboak Dr, from just S of Teague Rd



Looking N along Pine Village Dr, towards Truscon Dr



Looking NE along Lexford Ln, from S of Vogue Ln



Looking SW along Moorberry Ln, from N of Emnora Ln  $\,$ 

## APPENDIX 2 PIEZOMETER INSTALLATION REPORTS

PIEZOME'	TER INSTA	ALLATION I	REPORT
PROJECT NAME: WATER LINE REPLACEM WBS No.:S-00			PIEZOMETER NO.: B-23 (PZ-1)
GEOTECHNICAL CONSULTANT	DESIGN CONS	SULTANT	G
ASSOCIATED TESTING LABORATORIES, INC.	VanDeWiele &	Volger, Inc.	CITY OF HOUSTON
COMPLETION DATE:6-18-13			
DRY AUGERED0 TO15_ FT			
WASH BORED TO FT	D EDWIN		
DRILING FLUID:	DEPTH   (FT)  0		
DEVELOPMENT DATE:6-18-13			TYPE OF BACKFILL
METHOD OF DEVELOPMENT:BAILING		2 ft	CEMENT-BENTONITE  RISER TYPE PVC CASING
			I.D. 2"
WATER LEVEL READING:			TYPE OF SEAL  BENTONITE
DATE READING			TYPE OF COUPLING  THREADED
6-19-13 DRY		5ft	TYPE OF FILTER FILTER SAND
6-25-13 12.5'	9		SCREEN TYPE SLOT
7–30–13 9.0'			I.D. 2"
		5ft   %	SLOT SIZE0.01"
	<u>14</u> 15	1ft	TYPE OF BOTTOM CAP  THREADED PVC
		-	6"
	(NOT TO S	CALE)	
REMARKS:			
	DRILLED BY;	STARTED:	
NOTES:	VAN & SON	6-18-13	ATT :- N- 010 101
	LOGGED BY:	COMPLETED:	ATL job No. G13-164
	PV	6-18-13	
	CHECKED BY:	APPROVED BY:	
	JITU	PST	SHEET _1_ OF _3_
ASSOCIATE	D TESTING L	ABORATORIES.	INC.

PIEZOME	TER INSTA	ALLATION I	REPORT
PROJECT NAME: WATER LINE REPLACEN WBS No.: S-00	MENT IN HAM 00035-0180-		PIEZOMETER NO.: B-50 (PZ-2)
GEOTECHNICAL CONSULTANT	DESIGN CONS	SULTANT	GIMIL OF HOUSEN
ASSOCIATED TESTING LABORATORIES, INC.	VanDeWiele &	Volger, Inc.	CITY OF HOUSTON
COMPLETION DATE:6-18-13			
DRY AUGERED0 TO17 FT			
WASH BORED TO FT			
DRILING FLUID:	DEPTH (FT) 0		
DEVELOPMENT DATE:6-18-13  METHOD OF DEVELOPMENT:BAILING			TYPE OF BACKFILL CEMENT-BENTONITE
METHOD OF DEVELOPMENT:		4 ft	RISER TYPE PVC CASING I.D. 2"
WATER LEVEL READING:		1ft	TYPE OF SEAL  BENTONITE
DATE READING	6		TYPE OF COUPLING THREADED
6-19-13 DRY		5ft	TYPE OF FILTER FILTER SAND
6-19-13 16'	<u>11</u>		SCREEN TYPE SLOT
7–30–13 16'			I.D. 2"
		5ft	SLOT SIZE0.01"
	<u>16</u> 17	1ft	TYPE OF BOTTOM CAP  THREADED PVC
		-	6" -
	(NOT TO S	CALE)	
REMARKS:			
	DRILLED BY;	STARTED:	
NOTES:	VAN & SON	6-18-13	AMI : 1 N 040 404
	LOGGED BY:	COMPLETED:	ATL job No. G13–164
	PV	6-18-13	
	CHECKED BY:	APPROVED BY:	
	JITU	PST	SHEET _2 OF _3_
ASSOCIATE	ED TESTING L	ABORATORIES.	INC.

PIEZOME	TER INSTA	ALLATION F	REPORT
PROJECT NAME: WATER LINE REPLACEN WBS No.: S-00	MENT IN HAM 00035-0180-4		PIEZOMETER NO.: B-56 (PZ-3)
GEOTECHNICAL CONSULTANT	DESIGN CONS	SULTANT	CITY OF HOUSTON
ASSOCIATED TESTING LABORATORIES, INC.	VanDeWiele &	Volger, Inc.	
COMPLETION DATE:			
DRY AUGERED0 TO15 FT			
WASH BORED TO FT	   DEPTH		
DRILING FLUID:	(FT) 0		
DEVELOPMENT DATE: 6-18-13  METHOD OF DEVELOPMENT: BAILING		2 ft	TYPE OF BACKFILL CEMENT-BENTONITE  RISER TYPE PVC CASING L.D. 2"
WATER LEVEL READING:	<u>2</u> _3_		TYPE OF SEAL  BENTONITE
DATE READING	4		TYPE OF COUPLING  THREADED
6-19-13 DRY		5ft	TYPE OF FILTER FILTER SAND
6-25-13 14.5' 7-30-13 14'	9		SCREEN TYPE SLOT
	<u>14</u> 	5ft	I.D. 2"  SLOT SIZE 0.01"  TYPE OF BOTTOM CAP  THREADED PVC  6"
	(NOT TO S	CALE)	
REMARKS:			
NOTES:	DRILLED BY;  VAN & SON  LOGGED BY:  PV	STARTED: 6-18-13 COMPLETED: 6-18-13	ATL job No. G13–164
	CHECKED BY: JITU	APPROVED BY:	CURREN 3 AF 9
ASSOCIATE		ABORATORIES,	SHEET _3_ OF _3_ INC.

Attention Owner: Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation
Water Well DrillerPump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616
Toll free (800) 803-9202

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

Email address: water.well@license.state.tx.us  WELL REPORT												
						4143 A.						
THE RESERVE OF THE PROPERTY OF	Av	ddress	The second of the second			City	. anti	State	Zip 77002	, 1		
Name City of Houston Geotech Dept	6	11 Walker F	loor 14	****	20 30 D 20 EVE	Houston		Tx	1/002			
City of Housian Course						l City		State	Zip			
County Harris	P I	hysical Address Iammerly ar	ıd Pomeran	ı (pz-1)	1973	City Houston		Tx	77080	)		
O) E	Lat. °	1	"_Lo	ong.	0	t .	" Grid# 6			BTA		
New Well Reconditioning	A) Dropogod I	se (check)	Monitor	Environn	nental So	il Boring	Domestic	5)		NÎ		
Replacement Deepening	Industrial	_ Imigation _	i insantina	J I PHOUG NO	HWHV I	1 Lawrance	ring ∐ Testwel					
The second secon	Rig Supply	Stock or Lives	tock If Pu	iblic Supply, we	re plans aj	pproved? L	7162 114	식 <b>(</b>	•			
6) Drilling Date	Dia	meter of Ho				hod (chec	K)					
Started 6/18/2013	Dia (in)	From (ft)	To (ft)	Drive			Mind Rotary		-e.s			
	***	Surface		Borec			Cable Tool					
Completed <u>6/18/2013</u>	4	0	15	Jetted		Hollow Stem	Anger					
12				1 —	sse Circul			l				
ē	. 4.5			Other	•			<del>, , , , , ,</del>	Ct.	4 777-11		
				8) Boreh	iole Co	mpletion	Open H	ole 📙	Straigh 9 &	12		
0 15 SaCl	<u> </u>			Unde	r-ream	ed L_1 Gra	vel Packed	7 Omer	<u> </u>	. 14		
5 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			THE TANK A TRANS	Gravel Pac	ked inte	val from	ft. to	IL PAR				
, S.	Taga Million					I Company	and the second s	Setting	(4)	Gage		
				Dia.	Or	Perf. Slotted	Letc.		To	Casing Screen		
		and the state of t		(in.)		Screen Mfg	if commercial VC Riser	From	10	SMECH		
				2 2	n n		VC Screen	10	15	.010		
					44	TO-E		_12				
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						. ,		<u> </u>				
				9) Annu	lar Sea	ıl Data: i.	e. (from <u>0</u> ft to <u>100</u>	ft #sacks &	material <u>l</u>	3 cement)		
August August Weigen Stage Stage				from 0 ft. to 6 ft. #sacks & material 5 cement								
the second with					from 6 ft. to 8 ft. #sacks & material 5 bentonite							
16 x x x 4 x				from ft. to ft. #sacks & material								
13) Plugged	igged within 48	nours			المحد بمعلمات	d or other co	centrated contains	cation		ft		
Casing left in well: na Cement/Bentoni	te placed in well:			Distance to septic field or other concentrated contamination ft.  Distance to Property Line ft Method								
				Verified			i di 1971, alia Maria di Maria	31 / 28 . 4 5 <u>.</u>	%			
		**************************************	24 (2.2)	fft) Crist	ace Co	maletion	(If steel cased, leav	e blank)	ar yakta			
		· · · · · · · · · · · · · · · · · · ·	<del></del>	Cuefon	e Slah In	stalled	Surface Sle	eve Install	ed			
10 Tono Prome					Adapter		Alternative	:				
14) Type Pump	Submersible	☐ Cylinder	· · · · · ·	10	- 1.T' 144	8-3-20 - 10-10	C Admin appearance	30 d. m.				
☐ Turbine ☐ Jet				11) Wat			Date <b>6/1</b>	3/2013				
Other <u>na</u> Depth to pump bowls, cylinder, jet, etc.,	ft.			- Static level			1 at 11	A BANG BANG				
****				Artesian F		gpm	· ,	g-32-2	<del>an esta.</del> Barreta			
15) Water Test				12) Pack				100				
Type test  Pump  Bailer J	etted L Estimated	<b>1</b> Service System State				8-15	200 (200 (200 (200 (200 (200 (200 (200	× 14 14 14 14 14 14 14 14 14 14 14 14 14	er konstr			
Yield: <b>na</b> gpm withfl_drawdd	wn afterb	us.		20/40		0-13	200 2000 And 10 10 100	1.77	era ti			
				<u> </u>		بببب		4 4 5 4 4 5	1000			
16) Water Quality		s a great	tuo   Tr	Mar				. , .	•			
Type of water: Depth of Strata:	Was a ch	emical analysis	made! LIYes	No 16	Continu	a•	<u> </u>	St.	1 - M			
Did you knowingly penetrate a strata wi	nch contains undes	stranie constitue	ms/TT res F	☐ rimin	ocathone Ozninen	c. (i.e. gas, oi	Letc.)	e partire				
<b>一</b> 二	or-quality groundw		storod	Clother	(descrit	ne)		1 N 1				
☐ I certify that while drilling, deepeni	aterial/waste conta	unitation encous	dosarihad wall	1 undesirable	water or	constituents	was encountered	and the la	ndowner	was		
I certify that while drilling, deepend informed that such well must be comple	ng, or omerwise all ted or plugged in s	uering uie aoove uch a manner as	to avoid injur	y or pollution.	: T 35 - 37	181, HW (5.142			•			
Company or Individual's Name	(type or print)	Van and So	ns Drilling	Service, In	c	i si iy	Lic. No. 29		<u> </u>			
Address 319 John Alber	Cor-	**************************************	City He	ouston	in Land. Y <u>ankan is</u> a		State Tx	Zip	77076			
		6/24/2		Signature		-			7			
Signature						egatarie.						

### Attention Owner:

Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation
Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616
Toll free (800) 803-9202
Email address: water well@license.state.tx.us
WELL REPORT

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

							ANTA:					
Name			Address				City		State	Zip	. [	
City of Houston G		. 5.1	611 Walker	Floor 14	: ::::::::::::::::::::::::::::::::::::		Houston		Tx_	77002		
City of Houston G	THE PROPERTY OF THE PARTY OF TH	TO THE OWNER OF THE PARTY OF TH			2 Aure 3							
County		TO STATE OF THE ST	Physical Address				City	***	State	Zip 77080	, 1	
Harris	•		Truscon and		z-2)		Houston		Tx	1/080	,	
		Y.at G	, t	n T	ong.	0	t	" Grid# 6	5-12-6			
3) Type of Work		Lau				nental Co	oil Boring	Domestic	5)		N↑	
		4) Proposed	use (cneck)	☐ Monitor	T ETIAIO	mak.	De mester	ing Testwel	1 -			
Replacement	Deepening	Industrial		Injection	Transic 2	abbia		Yes No	,			
		Rig Supply	Stock or Live		ublic Supply, we				$\exists$ (	)		
6) Drilling Date		Di	ameter of H				thod (chec					
Started 6/1	8/2013	Dia. (in)	From (ft)	To (ft)	Drive	en 📙	Air Rotary	Mud Rotary				
		·	Surface		Bore	_	Air Hammer	Cable Tool				
Completed 6/1	8/2013	4	0	17	Jette		Hollow Stem	Auger				
Companie		· · ·	<u>.</u>			rse Circul			L			
				1	Othe	•	_					
					8) Rorel	ole Co	mpletion	Open Ho	ole 🗌	Straigh	t Wall	
					Finde	r-ream	ed Gra	vel Packed	Other	98	12	
0 1	7 SaCl		· <u>· · · · · · · · · · · · · · · · · · </u>		Gravel Pag	ked inte	rval from	ft. to	ft.	- <del></del>		
					Giaverrae			DV SSSSS				
			·		5,000 4,00	New	Steel, Plastic,	etc.	Settin		Gage	
a jan			<del></del>		Dia.	Or.	Derf Slotted	, etc. if commercial	From	То	Casing Screen	
				<del></del>	(in.) 2	usea n	Sch 40 P	VC Riser	0	.12		
	<u> </u>	<u> </u>			2	n	Sch 40 P	VC Screen	12	17	.010	
					<del></del>	<del>-</del>						
<b></b>												
·					9) Annu	lar Se	al Data: i.e	. (from <u>0</u> ft to <u>100</u>	ft #sacks &	material <u>i</u>	3 cement)	
					from 0	ft.	. to <u>8</u>	ft. #sacks & ma	terial <u>.5</u>	cement		
					from 8	<u>f</u> î	to 10	ft. #sacks & ma			ite	
166	are and all	<b>8.9.03</b>	P. Marting		from		. to	ft. #sacks & ma	terial			
13) Plugged	Well plu	gged within 4	8 hours		Method U	Method Used tremmie						
Cosing left in well: na	Cement/Bentoni	ite niaced in well:				Distance to septic field or other concentrated contamination ft.						
Casing left in well- int		A CONTRACTOR OF THE PARTY OF TH		AND SAN	Distance to	o Proper	ty Line	ft Method		i i i i i i i i i i i i i i i i i i i		
					Verified:		-	Africa de la companya del companya del companya de la companya de			entropy — Approximate	
					10) Sur	face Co	ompletion	(If steel cased, leav	e blank)	artair to		
					Surfac	10) Surface Completion (If steet cased, leave blank)  Surface Slab Installed Surface Sleeve Installed						
14) Type Pump					Pitless	Adapter	Used	Alternative	Procedu	e Used		
Turbine	] Jet	Submersible	Cylinder Cylinder		11) Wat			The second secon	. <del></del>	rer ser		
Other na					- Static leve			Date 6/13	3/2013			
Depth to pump bowls,	cvlinder, iet. etc	ft.			Artesian F		- gpm					
	-0,				12) Pacl		&Prin					
15) Water Test			_									
Type test Pump					20/40				erice of Section	प्रकार है। इ.इ		
Yield: na gpm with _	ft. drawdo	own after	hrs.		20/40		10-17					
							L,			<u> </u>	والإستعدومي ويست	
16) Water Qualit	<b>y</b> ,			<b></b>	571							
Type of agreer	Depth of Strata:	Was a c	hemical analysis	made?   Ye	s ⊠ No	a						
Did you knowingly per	ietrate a strata wi	hich contains und	esirable constitu	ents? Yes	ĭ No If yes,	Continu	e: - ^ +	-t- \				
Check One:	Naturally poo	or-quality ground	water - type		Hydr	ocarbon:	s (i.e. gas, oil	, ecc.)				
i i	Hazardous m	aterial/waste conf	tamination encor	intered	∐ Othe	r (descri	be)		1 X 25.25		*1000	
I certify that while	drilling, deepeni	ng, or otherwise o	altering the abov	e described we	II, undestrable	water or	constituents	was encountered	ana me i	unuuwnen	wus	
informed that such wel	l must he comple	ted or plugged in	such a manner a	is to avoia infu	ry or poutution.			Lic. No. 29		·		
Company or Indiv	idual's Name	(type or print)	Van and S	ons Drilling	Service, II	ic .	T <sub>2</sub>			77076		
Address 319 Joh				City H	ouston	<u>.</u>		State Tx	Zap	,, , U / U		
Signature			6/24/	2013	Signature		AND THE RESERVE OF THE PARTY OF			1.,		
pignature			The second second								No. of the last	

#### **Attention Owner:**

Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program

P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616

Toll free (800) 803-9202

Email address: water.well@license.state.tx.us

WELL REPORT

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

TODANCE ASSESSMENTATION OF THE CONTROL OF THE CONTR													
Name		Address				City	State	Zip					
City of Houston Geotech Dept			611 Walker Floor 14				Houston	CAROLIV MIN	Tx	77002			
	CATE OF STREET												
County			Physical Address			2)		City Houston		State Tx	Zip 77080		
Harris		r	Knoboak and Teague (pa					Honzion			1		
3) Type of W	ork	Lau	0 1		Long		0		'   Grid # 6				
New Well	Reconditioning	4) Proposed	Use (check)	☐ Monito				oil Boring	☐ Domestic	1 -	j	N↑	
Replacement	☐ Deepening	Industrial	☐ Irrigation	Injection	ı [	Public S	upply	De-waterii	ig Testwe	Щ			
	."	Rig Supply	Stock or Live	stock I	f Public	Supply, w	are plans a	pproved?	Yes N	0	`		
6) Drilling Date D						7) Drilling Method (check)							
Started	6/18/2013	Dia. (in)	From (ft)	To (ft)		Driv	en 🗌	Air Rotary	Mud Rotar	7			
-		-	Surface			Bore	ed [	Air Hammer	Cable Tool				
Completed _	6/18/2013	4	0	-15	.	Jette	ad [	Hollow Stem A	uger				
,						==	erse Circul						
						Othe	adry a	uger					
	District Const					8) Bore	hole Co	ompletion	Open H	ole 🔲 :	Straight V	Vall	
0	15 SaCl				29/20/20/2	8) Borehole Completion ☐ Open Hole ☐ Straight Wall ☐ Under-reamed ☐ Gravel Packed ☒ Other 9 & 12							
				<del></del>		Gravel Packed interval from fl. to ft.							
h						Order to the market and the second se							
							New	Steel Plastic e	tc.	Setting	(ft) Gag	ge	
		<del> </del>				Dia. (in.)	Or Used	Perf., Slotted, e Screen Mfg., if	tc. commercial	From	To Scn		
			-			2	n ·	Sch 40 PV	C Riser	0	10		
						2	n	Sch 40 PV	C Screen	10	15 .0	010	
						N 4	Jan Car	1 Detec		6 4			
						9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement) from 0 ft to 6 ft #sacks & material .5 cement							
		*											
	Section Section 5			·									
13) Plugged	☐ Well plu			The state of the s		fromft. toft. #sacks & material							
	: na Cement/Bentoni					Distance to septic field or other concentrated contamination ft.							
Casing icit in wen	STATUTE OF STREET			d Kalle Carlo		Distance te	Propert	v Line	ft Method				
					7	Verified:							
							ace Co	mpletion (1	f steel cased, leav	e blank)	Tr		
		300				Surfac			Surface Sle				
14) Type Pum	lD								Alternative	Procedure	Used		
☐ Turbine ☐ Jet ☐ Submessible ☐ Cylinder						Pitless Adapter Used Alternative Procedure Used  11) Water Level							
Other na						Static level dry ft. Date 6/18/2013							
Depth to pump bowls, cylinder, jet, etc., ft.						Artesian Flow gpm							
15) Water Tes							12) Packers						
15) Water Test													
Type test Pump Bailer Jetted Estimated Yield: na gom with ft. drawdown after hrs.					F	20/40		8-15		ार अध्यक्षका हु <b>र</b>	3, 537	****	
Yield: <u>na</u> gpm w	mi ir. drawdo	wn aner	hrs.		ľ	20/40		<del>0-13</del>			<del></del>		
	14/					Annan and an analysis of the same of					•. '		
16) Water Qu	•	W/	hemical analysis		700 V	No							
Type of water:	Depth of Strata:						Continue	<b>.</b> •					
Did you knowingly penetrate a strata which contains undesirable constituents? Yes No If yes, Continue:  Check One: Naturally poor-quality groundwater – type Hydrocarbons (i.e. gas, oil, etc.)													
Check One: Naturally poor-quality groundwater – type Hydrocarbons (i.e. gas, oil, etc.)  Hazardous material/waste contamination encountered Other (describe)													
I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was													
informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.													
Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 2903M													
Address 319 John Alber City House								Sta	ate Tx	Zip 7	7076		
	COMPLEXABLE		6/24/2		Signa					1	1		
Signature	O DOMESTIC OF THE OWNER O		JI M TI M		343 43 63 2	5807.0076000000						13.00	

**Texas Department of Licensing and Regulation** Water Well Driller/Pump Installer Program
P.O. Box 12157 Austin, Texas 78711 (512) 463-7880 FAX (512) 463-8616 This form must be completed Attention Owner: and filed with the department Confidentiality Privilege Notice and owner within 60 days Toll free (800) 803-9202 Email address: water well@license.state.tx.us upon completion of the well. on reverse side of owner's copy. WELL REPORT 77002 Houston 611 Walker Floor 14 City of Houston Geotech Dept Physical Address Houston 77080 Hammerly and Pomeran (pz-1) Harris " Grid# 65-12-6 " Long. Lat. 3) Type of Work 4) Proposed Use (check) Monitor Environmental Soil Boring NT Domestic New Well Reconditioning Industrial Irrigation Injection Public Supply De-watering Testwell Replacement Deepening If Public Supply, were plans approved? Yes No Rig Supply Stock or Livestock 7) Drilling Method (check) Diameter of Hole 6) Drilling Date To (ft) Driven Air Rotary Mud Rotary From (ft) Dia (in) 6/18/2013 Started Air Hammer Cable Tool Bored Surface Hollow Stem Anger Jetted. 0 15 6/18/2013 Completed Reverse Circulation Other dry auger Under-reamed ☐ Gravel Packed ☒ Other 15 SaCl Gravel Packed interval from ft. to ft. WALL THE HOLD WALL TO THE WALL Setting (ft) Steel Plastic, etc. 1 - 1 1887 Dia. Screen Mfg, if commercial (m.) . . . 10 Sch 40 PVC Riser 2 n 15 .010 10 Sch 40 PVC Screen 2 9) Annular Seal Data: i.e. (from 0 ft to 100 ft #sacks & material 13 cement) ft to 6 ft #sacks & material 5 cement from 0 ft. #sacks & material .5 bentonite from 6 ft. to 8 CONTRACTOR CONTRACTOR AND CONTRACTOR ft: #sacks & material \_ ft. to from ☐ Well plugged within 48 hours Method Used tremmie 13) Plugged Distance to septic field or other concentrated contamination Casing left in well: na Cement/Bentonite placed in well: Distance to Property Line ft Method \_\_\_ 10) Surface Completion (If steel cased, leave blank) Surface Sleeve Installed Surface Slab Installed Alternative Procedure Used Pitless Adapter Used 14) Type Pump Submersible Cylinder | ☐ Jet 11) Water Level Turbine Dafe 6/18/2013 Other na Static level dry ft. Depth to pump bowls, cylinder, jet, etc., Artesian Flow 12) Packers 15) Water Test Type test Pump Bailer Jetted Estimated 8-15 Yield: 11a gpm wifti ff. drawdown after brs. 20/40 16) Water Quality Type of water: \_\_\_\_\_ Depth of Strata: \_\_\_\_\_ Was a chemical analysis made? Yes No Did you knowingly penetrate a strata which contains undesirable constituents? Yes No If yes, Continue: Hydrocarbons (i.e. gas, oil, etc.) Naturally poor-quality groundwater - type Check One: Other (describe) Hazardous material/waste contamination encountered I certify that while drilling, deepening, or otherwise altering the above described well, undesirable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution. Company or Individual's Name (type or print) Van and Sons Drilling Service, Inc Lic. No. 2903M Zip State Tx

City Houston

Signature

6/24/2013

Address 319 John Alber

mark to budge to

#### Attention Owner:

Confidentiality Privilege Notice on reverse side of owner's copy.

Texas Department of Licensing and Regulation

Water Well Driller/Pump Installer Program

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WELL REPORT

This form must be completed and filed with the department and owner within 60 days upon completion of the well.

TODANCE ASSESSMENT OF A PROPERTY OF A PROPER													
Name	Address				City			Zip					
City of Houston Geotech De	611 Walker Floor 14				Houston		Tx	77002					
ENDINE EN CLEANISTE							City		State	Zip			
County Harris	÷ :	Physical Address Knoboak an		(pz-	3)		Houston		Tx	77080			
	1- /	0 '				0	1	" Grid# 6	5-12-6				
3) Type of Work	Lat.	-		Long			oil Boring	Domestic		N↑			
	g 4) Proposed	Use (cneck)  Inrigation	∐ Montto	"					1 -	141			
Replacement Deepening	Rig Supply	·	injection	1 <u> </u>	Transco	mbbia l	De-waters	Yes N	6				
								Š	<b>)</b>				
6) Drilling Date	Diameter of Hole From (ft) To (ft)			7) Drilling Method (check) Driven Air Rotary Mud Rotar				_					
Started <u>6/18/2013</u>	Dia. (in)	1	10(11)			. —	i -	Mand Rotar	1				
~		Surface			Bore		Air Hammer Hollow Stem	_					
Completed <u>6/18/2013</u>	- 4.	0	15		Jette	nse Circul	•	ruger					
					==	a dry a							
						-							
TOWNS AND THE			and the second		8) Borel	hole Co	mpletion	∐ Open H	ole ∐ S	Straight Wall			
0 15 SaCl			/ 8# " 		☐ Under-reamed ☐ Gravel Packed ☒ Other 9 & 12								
-					Gravel Packed interval from fl. to ft. 5.5.								
					Dia.	l O⊤	Steel, Plastic, e Perf., Slotted, e	atc.	Setting	Casing			
					(in.)	Used	Screen Mfg., if	commercial	From	To Screen			
							Sch 40 PV Sch 40 PV		10	15 .010			
						n	SCH 40 F V	C Screen	10	15 .010			
						<del> </del>							
					)) Annu	lar Sea	l Data: ie.	(from <u>0</u> ft to <u>100</u>	ft #sacks & m	aterial 13 cement			
					from 0 ft. to 6 ft. #sacks & material .5 cement								
				1	from 6 ft. to 8 ft. #sacks & material 5 bentonite								
				1	from ft. to ft. #sacks & material								
13) Plugged	lugged within 4	8 hours			Method Used tremmie								
Casing left in well: <b>na</b> Cement/Bento	nite placed in well			j	Distance to septic field or other concentrated contamination ft.  Distance to Property Line ft Method								
Southern Association expense		and the section	d de l'Oak	I	Distance to	Propert	y Line	ft Method	·	-			
					Verified:		<u> </u>		e i gera				
				j	10) Surface Completion (If steel cased, leave blank)								
		L.			Surfac			Surface Sle	eve Installe	i			
14) Type Pump					Pitless Adapter Used Alternative Procedure Used								
☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder					11) Water Level								
Other na					Static level dry ft. Date 6/18/2013								
Depth to pump bowls, cylinder, jet, et	Depth to pump bowls, cylinder, jet, etc., ft.						Artesian Flow gpm						
15) Water Test						kers		· ·.					
Type test Pump Bailer Jetted Estimated													
Yield: na gpm with ft. drawdown after hrs.					20/40	ŀ	8-15		1.4 (2)(1)(1)(2)				
		-		Γ									
16) Water Quality								•		•			
Type of water. Depth of Strat		hemical analysis											
Did you knowingly penetrate a strata which contains undesirable constituents? Yes No If yes, Continue:													
Check One: Naturally poor-quality groundwater - type Hydrocarbons (i.e. gas, oil, etc.)													
Hazardous material/waste contamination encountered Other (describe)													
I certify that while drilling, deepening, or otherwise altering the above described well, undestrable water or constituents was encountered and the landowner was informed that such well must be completed or plugged in such a manner as to avoid injury or pollution.													
informed that such well must be comp	leted or plugged in	such a manner as	to avoid inj	tary or	pollution.								
Company or Individual's Name (type or print) Van and Sons Drilling Ser						<u>c.</u>		Lic. No. 290		1076			
Address 319 John Alber City Hous					on .		St	ate Tx	Zip 7	7076			
Signature		6/24/2	<b>013</b>	Signa	ture				/	/ 			

## APPENDIX 3 BORING LOGS AND KEY TO LOG TERMS AND SYMBOLS

	4 -			AT-4: Inhandaria In				LOG O	F B	ORII	NG	<b>B-</b> 1	PAGE 1 OF 1	DAT	TE			6/	7/2013
	AS	SO	cıaı 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	Pł	ROJEC	CT:	Proposed Water Lin WBS No. S-000035	e Re	placer	nent	in H	łammerly Area	SUF	RFAC	E ELI	EVAT		9. <i>63</i>
			ŀ	Iouston, Texas-77054	PF	ROJEC	CT N	NO.: G13-164		PRING T	YPE:	Au	ıger	(%)	1	ERBI MITS(		(%)	- 9), 4RKS
				LOCATION		(S)		● <i>N (blows/ft)</i> ● 20 40 60 80	c)c	OMP.	(%) ^		Natural Moisture Content	→ .				PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
(:		JSC	EVEL	Emnora Ln.		INT (*)	(10)	<b>▲</b> $Q_u$ (tsf) <b>▲</b> 1.0 2.0 3.0 4.0	A) YTI	IED CC 4 (tst)	STRAII	3 ⊑ (psi)	and Atterberg Limits	CONTENT	LIMIT	C LIMI	II YTIC	£200 S	ED ANG FRIC
DEРТН (ft.)	SAMPLES	,,,,	TERL	Northing: 13861609.35 Easting: 3064059.05	(E7	BLOW COUNT	OWS/17	★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Moisture Liquid Limit Content Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	ESTIMATE INTERNAL OTHER TE
l _ l			W	MATERIAL DESCRIPTION	POCK	BLOV N B	و (ک ایک	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DRY	UNC	FAI	CON	20 40 60 80	MOI	LL	PL	PI	PAS	EST INT OTF
				3" Asphalt 7" Gravel with sand Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tanhard below 2'	3.5 4.5								φ <b>Η-1</b>	11 10	33	16	17	52	
- 5 - - 5 - 	C			with ferrous nodules below 6'	4.5 4.5				117	2.25		0		8					
 					4.5			•					OH1	13	36	17	19		
- 10 -  	Si	M		Silty Sand (SM), medium dense, non plastic, light gray and tan		17								13				48	
Water Water Dry Samp	r Obsi	erva	tions.	ntial:   After Drilling  24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:  PT   Shelby Tube   Disturbed		N - SI P - Po T - To Q <sub>u</sub> - Ui	PT ock orva nco	eviations: Data (Blows/Ft) ket Penetrometer (tsf) vane (psf) onfined Comp. Strength (tsf) Density (pcf)		gered i			Hole Grouted after Drilling. Checked By: Jitu/John, QC/				nnsor	n and	l Sons ,

	/	1 cca	cia	ted Testing Laboratories, Inc.			LOG OI	= B(	ORIN	NG I	B-2	2 PAGE 1 OF	1 DA	TE			6/	10/2013
	7	1330	(	3143 Yellowstone Blvd	PRO	OJEC	CT: Proposed Water Line WBS No. S-000035-	e Rep 0180	olacen )-3	nent	in F	Hammerly Area	SU	RFAC	CE EL	EVAT		7.81
			1	Houston, Texas-77054	PRO	OJEC	CT NO.: G13-164		RING T	YPE:	Αι	uger	(%)		TERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°). OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ict)	OMP.	(%) N		Natural Moisture Content and	CONTENT		7	NDEX	PASSING #200 SIEVE (%)	GLE O TION ( & REM
t.)	(0)	US	EVEL	Emnora Ln. Northing: 13861626.73	METER	JNT oot)	A O (tsf) A	д) ҮТІ	VED C. H (tsf)	STRAIL	G E (psi)	Atterbera Limits		LIMIT	C LIMI	CITY I	#200 S	ED AN L FRIC ESTS a
DEРТН (ft.)	SAMPLES	000	)  TERL	Easting: 3064586.67	POCKET PENETROMETER(P,tst	BLOW COUNT (N, Blows/Foot)	* DD (pcf) * 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE	Plastic Moisture Liqu Limit Content Lim ⊢ — — — — — —	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING	TIMATI ERNA HER TI
O E	SA		W	MATERIAL DESCRIPTION	POCKET PENETF	BLOV (N, BI	Ď	DRY	UNC	FAI		20 40 60 80	MOI	LL		PI	PAS	ES: INT OT!
[ "	$\mathbb{Z}$			8" Concrete														
r	$\sqrt{}$			Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0		<b>*</b>					φ	14					
<u> -</u>				with sand pocket below 2'	2.5			118	0.85		0	(1) →	14	35	16	19	53	
-	4			very stiff below 4'	3.0								15					
- <i>5</i> -		CL		stiff with sand seam below 6'	2.0		•	114	0.55		0		17					
-  -  -					2.0							Φ	16					
- 10 - -		SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		18	7					Φ	13				21	
												<u>В</u>						
Dry	er Ol	bserva	ations	Intial: ♀ After Drilling▼ 24 Hrs: ▼ s: Initial Water Level: Dry, After Drilling Water Level:  SPT	N P T Q	- SF - Po - To ), - Un	obreviations: PT Data (Blows/Ft) Ocket Penetrometer (tsf) Orvane (psf) Inconfined Comp. Strength (tsf)		gered t			Hole Grouted after Drilling Checked By: Jitu/John, Q				nnsoi	n and	d Sons ,

	/	1 990	oiat	ad Tasting Laboratories Inc						LO	G O	F B	ORII	<b>VG</b>	B-3	3		PAGE	1 OF 1	DA	TE			6/	/10/2013
	F	1550	3	ed Testing Laboratories, Inc. 1443 Yellowstone Blvd	PF	ROJECT	: Р	ropo	sed l	Wate	er Line 0035-	e Rep	olacen	nent	in H	lami	merly	Area		SUI	RFAC	E ELI	EVAT		7.86
			H	Houston, Texas-77054	PF	ROJECT					0000-		-U RING T	YPE:	Au	ıger				(%)		ERBI MITS(		(%)	= °), 4RKS
				LOCATION	of of	(161, 1			(blows 10 6		<b>•</b> 80	ct)	OMP.	(%) N		N	atural N	loisture (	Content	CONTENT (		7	NDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
(;	,	USO	EVEL	Emnora Ln. Northing: 13861632.22	0717	INT Jot)	1.	.0 2	Q <sub>u</sub> (ts:	f) <b>^</b> 3.0	4.0	g) YT!8	VED CO H (tsf)	STRAII	G E (psi)			and berg Lim			LIMIT	C LIMI	CITY II	#200 S	ED ANGLI
DEРТН (ft.)	SAMPLES	000	TERL	Easting: 3065116.21	KET	BLOW COUNT (N, Blows/Foot)		0 1	DD (pa 00 1	10	120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (	Plas Lin	stic N nit (	Moisture Content 	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING	ESTIMATE INTERNAI OTHER TI
O DE	SA		W	MATERIAL DESCRIPTION	POCKI	BLOV (N, B)			P (tsf)		<b>♦</b> 4.0	DRY	UNC	FAI	CON		20 4	0 60	80	MOI	LL	PL		PAS	ES: INT OTI
	И		7 5 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	7" Concrete			:									:				17	,,	10	00		
	$ \sqrt{} $			Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	2.0			•	•							(	<b>)</b>	4		17	44	18	26	61	
   				with ferrous nodules below 2'	2.5							110	0.95		0					17					
	$\parallel$																								
				with sand seam below 4'	1.5															16					
- 5 -	$\mathbb{I}$						:										). : : :								
	1			very stiff below 6'	4.0															17					
	$\parallel$	CL									•						)			-					
	$\dagger$				3.0							113	1.58		6					17					
	$\parallel$							<b>A</b>		<b>*</b> *							)· · · · · · ·								
- 10 -					3.5															17	38	17	21	52	
	$\parallel$									•						(				-					
	$\dagger$			stiff below 12'	2.0			•	•											16					
	$\dagger$							i i	11	.i i	.11						.i i i		111						
Wate Wate Dry				Intial: ☑ After Drilling.▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level:		to Abbi V - SP P - Poo T - Tor	reviation T Data Cket Pervane (	i (Blovi enetro	vs/Ft) meter	(tsf)			gered i						rilling. Di ohn, QC/				son a	and S	Sons ,
Samp	ole I	Kev:	$\boxtimes s$	SPT	1 (	າ - 101 Qູ - Und DD- Dry	confinè	ed Cor	np. St f)	rengti	h (tsf)		-		•		,		•		-				

		1 ~ ~ ~		tod Testing I about toning Inc					L	OG C	)FB	ORII	NG	B-4	4	PAGE	1 OF 1	DA	ΓΕ			6/	/11/2013
	Α	1SSO	ciai 3	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PRO	DJECT:	: Pr	opos	ed W	ater Li	ne Re	placer	ment	t in H	lammer	ly Area		SUF	RFAC	E ELE	EVAT		7.08
			I	Houston, Texas-77054	PRO	)JECT			10. S-0 3-164	000035		D-3 DRING T	ΓΥΡΕ:	AL	ıger			(%)		ERBE			
	T			LOCATION	P,tsf)		20		blows/ft 0 60		Je (je	JMP.	(%) ^		Natura	al Moisture	Content	• .			_	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		1104	EVEL	Emnora Ln.	ETER(	of)		<b>▲</b> G	Q <sub>u</sub> (tsf) 0 3.0	<b>A</b>	TY (pcf)	ED CC I (tsf)	TRAIN	; (psi)	A	and tterberg Lin	nits	CONTENT	-IMIT	FIMI	II YTI	200 SI	D ANGL. FRICTIC STS & F
DEPTH (#.)	SAMPLES	USC	YER LI	Northing: 13861637.12 Easting: 3065588.98	ET TROM	BLOW COUNT (N, Blows/Foot)	90	★ DI	D (pcf) 0 110	*	DRY DENSITY	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	# SING	ESTIMATE INTERNAL OTHER TE
DEF	SAN		WA	MATERIAL DESCRIPTION	POCKI PENET	BLON (N, Bk	<b>♦</b> 1.0	· F	o (tsf) 0 3.0	•	DRY	UNC	FAIL	CON	+ 20		· <del>-</del>	MOIS	IL LL	PL	PI	PAS	EST INTE OTH
- <i>U</i> -	I	ý	2 4	7.25" Concrete			: :		: :	: : :													
- 	$\int$			Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5					•					<b>φ-</b> -	4		11	34	16	18	58	
   				with calcareous nodules below 2'	4.5					•								12					
	Ц			very stiff with ferrous nodules below 4'	3.5													13					
- 5 -	$\frac{1}{2}$			very dam marrienede neddies sellem 1						<b>+</b>	_												
- 	$\frac{1}{1}$				4.0													15					
   L -		CL								•													
	$\left  \right $				4.5					<b>k</b> •••	114	1.95		0	φ			16					
- 10 -	H			stiff below 10'	1.75													21	48	18	30	70	
- 	$\frac{1}{2}$							•										-					
   	I				2.0			•							d d			17					
Dry	r Ob	bserva	ations.	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:	P T Q.	- SPT - Poc - Torv - Unc	T Data ket Per vane (p confine	(Blows netrom osf) d Com	neter (ts p. Strei	sf) ngth (tsf)	Lo	igered i				ed after D By: Jitu/Jo					son a	and S	Sons ,
Samp	ole ł	Kev:	X .	SPT 🛮 Shelby Tube 🗐 Disturbed	DΪ	) - Drv	Densit	ty (pcf)	i	- ' '													

								LC	OG O	F B	ORIN	NG	B-5	5	PAG	E 1 OF 1	DA	ΤE			6/	11/2013
	Α	Associa	uted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRC	JECT	: P	ropose	ed Wa	ater Lin	e Rej	olacen	nent	in H	amme	rly Area		SUI	RFAC	E ELI	EVAT	ION	7.84
			Houston, Texas-77054	PRC	JECT		7BS No -G13		000035-		ı-3 RING T	YPE:	Au	ger			(%)		ERBI MITS(			
			LOCATION	c,tsf)		•	N (b)			<i>θ</i>	MP.	(%)		Natur	al Moisture	Content	→ .			_	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
			Emnora Ln.	TER(I	\$ ₹	1	$\begin{array}{c c} \bullet & 40 \\ \hline \bullet & Q_{\iota} \\ 0 & 2.0 \\ \end{array}$	(tsf)	<b>A</b>	77 (pc	ED CO	TRAIN	(psi)	A	and Atterberg Lii	mits	CONTENT	IMIT	- LIMIT	NI YTI:	300 SII	O ANG FRICT STS &
DEPTH (#.)	SAMPLES	USC L	비 Northing: 13861652.08 표 Easting: 3066063.86	ET TROME	BLOW COUNT (N, Blows/Foot)		★ DD	(pcf)	± 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Limit		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	NING #2	ESTIMATEI INTERNAL OTHER TE
DEF	SAN	2/4	MATERIAL DESCRIPTION	POCKI	N, Blo	1	P	(tsf) 3.0	•	DRY	UNC	FAIL	CONI	⊢ – 20		-	MOIS	LL	PL PL	PI PI	PASS	ESTI INTE OTH
「 0 <sup>≥</sup>	$\forall$	2 6	7.5" Concrete		() (E)	- /.	.0 2.0	3.0	4.0					20	40 60	: : :		LL	1 L	- 1		
-	1		Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.0				•						φ			. 17					
   			with calcareous nodules below 2'	2.5				<b>*</b>						<b>-</b>			18	42	18	24	68	
 - 5 -			with ferrous nodules below 4'	3.5					<b>+</b>	_				— <b>•</b>			15					
				4.0					•					φ			16					
		CL		3.5			<b>A</b>	*	<b>*</b>	110	1.25		0	•			20					
- 10 - 			stiff below 10'	2.0			•			-				<b>+</b> -			19	37	17	20	68	
   				1.5			•							•			17					
Dry	· Ol		Intial: ♀ After Drilling.▼ 24 Hrs: ▼ ns: Initial Water Level: Dry, After Drilling Water Leve  SPT ☑ Shelby Tube ☐ Disturbed	T. N	- For Und	T Data ket Pe vane ( confine	: (Blows/ enetrome	'Ft) eter (ts o. Stren	f) ngth (tsf)		gered t				ted after L By: Jitu/J					son a	and S	Sons ,

		4	. ,							L	OG C	)F E	80	RIN	IG I	B-6	<b>)</b>	PAG	E 1 OF 1	DAT	TE			6/	10/2013
	F	Associ	iat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PF	ROJECT	r: F	Prop	pose	d Wa	ater Lii	ne Re	epla	acem	nent i	in H	amme	rly Area		SUF	RFAC	E ELI	EVAT	ION	5.86
			H	Iouston, Texas-77054	PF	ROJECT					000035			s NG TY	/PE:	Au	ger					ERBI VITS(			
				LOCATION				•	N (blo	ows/ft,			Ş		(%)		Natui	al Moisture	Content	ENT (%)	LIII	VII 1 3(	_	VE (%	.E OF ON (°). REMAI
			/EL	Emnora Ln.	i L	ן הור (י		<u>20</u> ▲	40 Q <sub>u</sub>	60 (tsf)	<b>A</b>	7 (pcf		(tst)	RAIN	(bsi)	,	and Atterberg Li	mits	CONTENT	MIT	LIMIT	INI YT	OO SIE	ANGI FRICTI
DEPTH (ft.)	SAMPLES	USC	ER LE	Northing: 13861688.07 Easting: 3066954.76	T:	BLOW COUNT (N, Blows/Foot)		<u>1.0</u> ★ 90	DD	(pcf)	4.0 ★ 120	DRY DENSITY (pcf)	1,4,1	STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Liquid		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEP.	SAM		WAT		POCKE	SLOW N, Blov		<b>♦</b>		(tsf)	•	 DRY L		STRE	FAILL	CONF	⊢ – 20	40 60	·-	MOISTURE	2/7	PL	PI	PASS	ESTIMAT INTERNA OTHER 1
- 0 :	$\downarrow$	P4		6.5" Concrete	ŀ	<u> </u>	1	1.0	2.0	<u> </u>	4.0							40 00							
<u> </u>	1			Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	4.0						•						₽	<del>-</del> -1		17	39	17	22	61	
   	$\frac{1}{\sqrt{1}}$			with ferrous nodules below 2'	4.0						•						<b>d</b>			12					
- ·				with calcareous nodules below 4'	3.5						<b>♦</b>					-				14					
	<u> </u>	CL			4.0				<b>A</b>		* •	110	5	1.6		0	0			15					
	<u> </u>				3.5						<b>*</b>	116	5	1.33		6	φ			14					
- 10 ·	1				4.0						•					-	φ			16	47	18	29		
	4				3.5						<b>•</b>						0			18					
Dry	r O	bservatio	ons:	ntial: ☑ After Drilling.▼ 24 Hrs: ▼ Initial Water Level: Dry, After Drilling Water Level:		T - Toi Q <sub>ii</sub> - Un	T Dat cket F rvane confin	ta (B Pene (psf ned (	Blows/F etrome f) Comp.	tér (ts	f) ngth (tsf)	A						ted after L By: Jitu/J					son a	and S	Sons ,
Samp	ole i	Key:	$\!$	PT $oxine$ Shelby Tube $oxine$ Disturbed		DD- Dry	/ Den	sity (	(pcf)		- ' /														

									L	OG (	OF	BO	ORIN	<b>IG</b>	B-7	7		PAGE	1 OF 1	DAT	TE			<u></u>	11/2013
	F	Associa	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PF	ROJECT	Т: І	Prop	pose	d Wa	ater L	ine	Rep	olacen	nent	in H	lamme	erly i	A <i>rea</i>		SUF	RFAC	E ELI	EVAT	ION	5. <i>65</i>
			Houston, Texas-77054	PF	ROJECT					00003	35-0		-3 RING T	YPE:	Au	ger				(%)		ERBE MITS(			
			LOCATION	O tot	(161, 7		• 20	N (bl 40		80		(Ji	JMP.	(%) r		Natu	ıral M	oisture (	Content	→ .			_	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		1100	•1	750	VT (tc		_	$Q_{u}$	(tsf)	4.0		TY (pa	ED CC ' (tsf)	TRAIN	i (psi)		Attert	and perg Lim	its	CONTENT	IMIT.	FIMI	II YTI:	200 SI	D ANC FRIC: STS 8
DEРТН (#.)	SAMPLES	USC E	Northing: 13861709.45 Easting: 3067441.21	ET	BLOW COUNT (N, Blows/Foot)		<u>+</u> 90	DD	(pcf)	<b>★</b>		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	C	oisture	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #.	ESTIMATEL INTERNAL I OTHER TES
DEF	SAN	777	MATERIAL DESCRIPTION	POCKI	BLOW (N, BK		<b>♦</b> 1.0	P 2.0	(tsf) 3.0	<b>♦</b> 4.0		DRY	UNC	FAIL	CON	<b>⊢</b> −		<i>→ – – 60</i>	—	MOIS		PL	PI	PAS	EST INTE OTH
- 0	П	9 6	5.5" Concrete			:	:	: :	: :	: :	:					: :	: :	: :	: : :						
_	$\sqrt{}$		Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5							<b>*</b>					9				12					
-    -			with calcareous nodules below 2'	4.5							•					Фн-	4			11	29	15	14	68	
- - 5			with ferrous nodules below 4'	4.5							•					<del>-</del>				12					
-		CL		4.5						*	•	122	2.25		0	0				12					
-	1		very stiff below 8'	3.5						•						<b>\</b>				17	48	18	30		
- 10 - -				2.5					•								)			24					
																	_								
Dry	er O	bservation _	Intial: ☑ After Drilling ☑ 24 Hrs: ☑ s: Initial Water Level: Dry, After Drilling Water Level:	1	T - Toi Q,, - Un	PT Dat cket I rvane confii	ta (B Pene (pst ned (	Blows/letrome f) Comp	tér (ts				gered t						rilling. Di hn, QC/				son a	and S	Sons ,
Sam	ole .	Key: 🛛	SPT $oxine$ Shelby Tube $oxine$ Disturbed		DD - Dry	y Den	ısıty (	(pct)																	

110.02	4.0	101.0.	•							L	OG O	F B	ORII	NG	B-	8		PAGE	1 OF 1	DA	TE			6/	13/2013
	Α	lsso	cıai 3	ted Testing Laboratories, Inc. 1143 Yellowstone Blvd	PR	OJEC	T: <b> </b>	Prop	ose	d W	ater Lin	e Rej	olacer	nen	t in F	lam	meri	ly Area		SUI	RFAC	E ELI	EVAT	ION	5.20
			1	Houston, Texas-77054	PR	OJEC					000035		ı-3 RING T	YPE:	: Aı	uger	r			(9)	1	ERBE MITS(			
				LOCATION	tst)				N (blo			6	MP.	(%)		٨	latura	l Moisture	Content	ENT (%)				EVE (%	LE OF ION (°) REMA
			VEL	Moorberry Ln.	TERU	F &	,	20 ▲		(tsf)	80 ▲ 4.0	77 (pcl	ED COI	TRAIN	(isd)		At	and terberg Lin	nits	CONTENT	TIMI	LIMIT	NI YTI	OO SIE	7 ANG FRICT, STS &
DEPTH (#.)	SAMPLES	USC	ER LE	Northing: 13861548.57 Easting: 3067808.41	ET TROME	BLOW COUNT (N, Blows/Foot)		*	DD	(pcf)	± 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE	Pla Lii	stic mit	Moisture Content	Liquid Limit	1	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEF	SAN		WA	MATERIAL DESCRIPTION	POCKET PENETE	BLOW (N, Blo		<b>♦</b>	Р (	(tsf)	<b>4</b> .0	DRY	UNCC	FAIL	CON	+	⊢ – – 20		<b>-</b> 1	MOIS	Ĭ LL	PL	PI	PASS	ESTI INTE OTH
0	V		p. 16	4" Concrete			1	1 1	:	: :									1 1 1						
	$\frac{1}{2}$			Sandy Lean Clay (CL), hard, high plasticity, light gray and tan	4.5						•					<b> </b> φ	) <b> </b>	-4		12	44	18	26	69	
- ·				hard with ferrous nodules below 2'	4.5						•									11					
- 5	$\frac{1}{2}$	CL		very stiff below 4'	4.0				<b>\</b>	*	•	112	1.6		0	-				8					
_ ·				hard below 6'	4.5						•					0				6					
- ·				with calcareous nodules below 8'	4.5						•						)			12					
- 10 ·				Sandy Fat Clay (CH), very stiff, high plasticity, light gray and tan with calcareous nodules	4.0						•					(	<b>∤</b>			16	54	19	35	67	
	$\frac{1}{\sqrt{1}}$	СН		with ferrous nodules below 12'	3.5						•						9			28					
										i ii	. 4 4 4								. i i i						
Dry	r Ob	oserva	ations	Intial: ♀ After Drilling▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level: 	Λ	to Abb I - SF P - Po To D - Un	PT Dat ocket F	ta (Blo Penet	ows/F	ter (ts	f) ngth (tsf)		gered i					ed after D By: Jitu/Jo					son a	and S	Sons ,
Samp	ole k	Key:	$\mathbb{N}$	SPT 🛮 Shelby Tube 🖺 Disturbed	Ĭ	D- Dr	y Den	sity (į	pcf)	01	J (10./														

											L	OG	) O	FB	3C	RIN	1G	<b>B</b> -9	9			PAG	GE 1	OF 1	DA	TE			6	/13/2013
	Α	1 <i>sso</i>	cıal 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PF	ROJECT	Т:	Pr	ropo	osed	d W	ate	r Lin	e Re	epi	lacen	nent	in F	lar	nme	rly i	4rea			SUI	RFAC	E EL	EVAT	ION	 5.93
			I	Houston, Texas-77054	PF	ROJECT							035-			3 ING TY	YPE:	Αι	uge	er					(%)		ERBI MITS(			
				LOCATION	-	(181)				l (blo						MP.	(%)		Γ	Natur	ral M	oisture	e Co	ntent	→ .		VII 1 O(	_	EVE (%	LE OF ION (°) REMA
			VEL	Moorberry Ln.	i L	t)			<b>A</b>	40 Q <sub>u</sub> (	60 (tsf)	$\blacksquare$		7Y (pc/		(tsf)	TRAIN	(isd)		Á	Atterl	and perg L	imits	:	CONTENT	TIMI	LIMIT	NI YTI	OO SIE	ANG FRICT
DEРТН (#.)	SAMPLES	US	C) ER LE	Northing: 13861968.58 Easting: 3068075.59	T:	BLOW COUNT (N, Blows/Foot)		90	*	2.0 DD ( 100	(pcf)	*		DRY DENSITY (pcf)		UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	P	lastic .imit	M	loistur Conten	e	Liquid Limit		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (%, OTHER TESTS & REMARKS
DEP.	SAM		WAT	MATERIAL DESCRIPTION	POCKET	SLOW N, Blov		<b>♦</b>	•	P (1 2.0	tsf)	•	<b>•</b>	DRY [		UNCC	FAILL	CONF		<b>⊢</b> − 20	 40			— - <b>I</b> 80	MOISTURE	97 LL	PL	PL	PASS	ESTIMAT INTERNA OTHER T
- 0 <del>`</del>   				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5					2.0	0.0		•						G	20					7					
					4.5								•							) <b> -</b> -1					10	25	15	10	51	
- 5 -					4.5								•						(	-					11					
		CL		with ferrous nodules below 6'	4.5					<b>A</b>		*	•	118	5	2.25		0	. (	)					8					
	$\int$			with calcareous nodules below 8'	4.5																				10					
- 10 - 		СН			4.5								•						(	<b>\</b>					11					
	1	СН		Sandy Fat Clay (CH), hard, very high plasticity, light gray and tan with calcareous and ferrous nodules	4.5								<b>•</b>							Þ	) - :		-		25	69	22	47	51	
																								_						
Water Water Dry Samp	r Ol	bserva	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube   Disturbed		to Abb N - SP P - Po T - To Q <sub>u</sub> - Un DD- Dry	PT Da cket rvan conf	ata ( Per e (p fined	(Blo enetro osf) ed Co	omet omp.	tér (ts	sf) ngth	(tsf)	A		ered t								ing. D n, QC/				son a	and	Sons ,

			100.db1 50010						LC	G OF	BC	DRIN	IG I	B-1	0	PAGE	1 OF 1	DA	TE			6.	12/2013
	Ass	ocia	ted Testing Laboratories, Inc.	   PR	OJEC	CT:	Pro	pose	ed W	ater Lin	e Rei	olacer	nent	in F	lamme	rly Area		SUI	RFAC	E ELI	EVAT	TON	
			3143 Yellowstone Blvd Houston, Texas-77054	' ' '	0020		WB	S No	o. S-0	000035	-0180	)-3	,,,,,,			,ou			\ A T 7	ERBL	EDC.	80	6.13
		•	10uston, 1 exus-77034	l			VO.: (	G13-	164		ВО	RING T	YPE:	Αι	ıger			(%)		ERBI MITS(		(%	F '9', ARKS
			LOCATION	P.tsf)	BLOW COUNT		• 20	N (bl 40	lows/ft 60	)	cf:	OMP.	(%) ^		Natura	al Moisture C	Content				PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (%). OTHER TESTS & REMARKS
		VEL	Vogue Ln.	TER	  -  -	٦_	<b>A</b>	$Q_{u}$	(tsf)	4.0	77 (p.	ED CC (tst)	TRAIN	(isd)	Α	and Atterberg Lim	its	CONTENT	TIMI	TIMIT	II YTI	1S 00	ANC FRIC:
DEPTH (ft.)	US	$C \mid \exists$	Northing: 13861403.15 Easting: 3066465.06	7 30ME	COUN	/s/F0C		: DD	(pcf)	*	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE	Plastic Limit	Moisture Content	Liquid Limit		LIQUID LIMIT	PLASTIC LIMIT	STIC	NG #2	NATEL SNAL R TE
DEPTH (ft.	5	WATE	MATERIAL DESCRIPTION	POCKET PENETE	OW NO	Blow —	<u>90</u> ♦	Ρ	(tsf)	120 ◆	HY D	INCO	-AILU	ONFI	<b>⊢</b> − ·			MOISTURE		1 1		ASSI	ESTIN NTEF OTHE
- 0		P 8	6" Concrete	P 9	B	<u> </u>	1.0	2.0	3.0	4.0		2 8		OF	20	40 60	80	≥	LL	PL	PI	Д	
	1		1" Stabilized gravel	3.5			i i										: : : : : : : : : : : : : : : : : : : :	19					
	/		Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan							<b>•</b>					$\varphi$								
<b>h</b>	1		plasticity, light gray and tall	4.0				!!										15	42	18	24	63	
-	/														l φ	<del>-</del>							
																	<u> </u>						
	1		with ferrous nodules below 4'	3.5														15					
- 5 -										<u> </u>													
+	1			4.0				<u>.</u>			117	1.55		o				15					
	CL							<u>.</u>		*													
	7		with calcareous nodules below 8'	3.0							-						( <u></u>	18	47	18	29	65	
-								ļļ							<b>├</b> -								
- 10						ļ																	
	1			2.5														21					
															γ								
<b>-</b>	1			4.0													:: : : : : :	16					
L ↓	′						.ii	<u>.</u>		<u>.i</u> i					: 0:		<u>:</u>						
147 :	/ /		Latin To After Delling To Cold	1/	45 41	- <b>I</b>	! = 4!				A.L.												
			Intial: ♀ After Drilling	Key N F	I - SI	SPT I	viations Data (B et Pene	Blows/	Ft)	·f)		gered i				ted after Dr					son a	and S	Sons ,
Dry					- 70 - TO	Orva Inco	ane (psi	f) Comp	Strat	ngth (tsf)	Log	gged B	3Y: P	V, C	hecked	By: Jitu/Jo	hn, QC/	QA E	3y: P	ST			
Sample	e Key:	$\boxtimes$ .	SPT $\square$ Shelby Tube $\square$ Disturbed		D- Di	ry D	Density	(pcf)	. Juei	igiri (tSI)													

110.02				1.67						L	00	G OF	BO	ORIN	١G	ì B	-1	1	PAGE	1 OF 1	DA	TE			6/	10/2013
	As	soc	iat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	T:	Pro	pos	ed	Wat	ter Lin	e Re	olace	me	nt in	Н	ammerly	/ Area		SUI	RFAC	E ELI	EVAT	ION	6.07
				Iouston, Texas-77054	DD	OJEC	T N/					00035		)-3 RING T	TVD	)E-	Διι	aer					ERBI		0	
	1								N (I			_	1	Τ.	Τ-	~ 1	<i>ا</i> ل				(%) LI	LII	MITS(		E (%)	OF N (°), EMAR
				LOCATION	B/P.ts			20	40	) (	60 f) <b>4</b>	80	(pct)	COMF	, 141	NIF N	i)	Naturai	Moisture C and	iontent	CONTENT		1IT	INDE	SIEV	NGLE CTIO 3 & RE
ff.)	$  _{\mathcal{U}}$	SC	LEVE	Vogue Ln. Northing: 13861427.74	WETE	UNT (poot)	<u> </u>	1.0	2.0	0 3	3.0	4.0	YTIS	NED TH (ts)	9	SI H	₹E (ps		erberg Lim Moisture			CIMI	//C 7/	YT/J/	#200	TED A IL FRI
DEPTH (#.)			TER	Easting: 3067085.03	KET ETBO	BLOW COUNT (N. Blows/Foot)		90	★ Di 10	0 1	110		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)		FAILUHE STHAIN (%) CONFINING	SSUF	Limit	Content	Liguid Limit — — -	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DE OF	5		W	MATERIAL DESCRIPTION	<i>POCKET</i> PENETE	BLOV (N. B.		<b>♦</b> 1.0		P (tst 0 - 3	f) 3.0	<b>♦</b> 4.0	ORY	UNC	147	CO	PRE	20	40 60	80	МОІ	LL	PL	PI	PAS	ES' INT OTI
	4	7		5" Concrete					: :	:	: :	: :														
-				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5							•						φ <b></b> -	1		12	37	17	20	67	
				with calcareous nodules below 2'	4.5																11					
												•									-					
_	1			with ferrous nodules below 4'	4.5																11					
- 5 - 	C	L			4.5					<b>A</b>		*	123	2.25		(	)	0			12					
					4.5													<b>0</b>	4		12	38	17	21		
- 10 -	7			stiff below 10'	3.0								100	0.85		8	3	\ \ \			24					
	7			very stiff below 12'	4.0			•				•									21					
							:	f																		
Dry	Obse	ervati	ions:	ntial: ♀ After Drilling▼ 24 Hrs: ▼ Initial Water Level: Dry, After Drilling Water Level:	آ F	to Abb I - SF - Po - To D Ur	PT D ocke	ata (l t Pen	Blows	netér	(tsf)	th (tsf)		gered				e Grouted hecked B						son a	and s	Sons ,
Sampl	e Ke	<b>/</b> :	$\mathbb{M} s$	PT $\square$ Shelby Tube $\square$ Disturbed	Ĭ	D- Dr	ry De	ensity	(pcf)	)		(.0.)														

		<b>4</b> • -	(-1T4: I -14:- I					L	OG C	)F E	30	RIN	G E	3-1	2	PAGE	1 OF 1	DAT	ΤΕ			6/	12/2013
	F	(	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PR	OJECT	T: F	Propos	sed W	ater Li 00003	ine F	Rep	lacen	nent	in H	amme	rly Area		SUF	RFAC	E ELE	EVAT		4.15
		Ì	Houston, Texas-77054	PR	OJECT							SING TY	YPE:	Au	ger			(%)		ERBE //ITS(		(%	= °), 4RKS
			LOCATION	(P.tsf)	BLOW COUNT (N, Blows/Foot)	2	20 4	(blows/1 0 60	80		ct)	ОМР.	(%) N		Natur	al Moisture and	Content	CONTENT (		7	NDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
f.)	S	USC HA	Eaglerock Dr. Northing: 13861769.96	METER	JNT oot)	1	.0 2.	Q <sub>u</sub> (tsf) .0 3.0	4.0		SITY (p	NED C	STRAI	IG IE (psi)		tterberg Lin			LIMIT	IC LIMI	ICITY I	#200 S	ED AN L FRIC ESTS
DEРТН (ft.)	SAMPLES	ATERI	Easting: 3068368.89	KET	W COI		90 10		* 0 120		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content 	Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SSING	ESTIMAT INTERNA OTHER T
	8	N N	MATERIAL DESCRIPTION	POCK! PENET	BLO (N, B	1		P (tsf) 0 3.0	→ 0 4.0		DR	UNU STF	FA	CO PRI	20	40 60	80	МО	LL	PL	PI	PAS	ES INT OT
	I	2 2 2	6.5" Concrete			:		: :		:					: :		: : :						
_	$\frac{1}{2}$		Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.0				•							φ <b>⊢</b> ⊣			9	26	15	11	60	
			with calcareous nodules below 2'	3.5														6					
- - - 5		CL	hard below 4'	4.5														12					
		CL	with ferrous nodules below 6'	4.5						•					φ			8					
- ·				4.5				<b>A</b>	*	1	23	2.25		0	0			11					
- 10 ·			very stiff below 10'	4.0					•						OH-	-1		12	40	17	23		
Wate Wate Dry			Intial: ∑ After Drilling.▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level:	N F T	- Tor	T Data cket P vane	a (Blow enetroi (psf)	netér (t	sf) ength (tst			ered to				ed after D By: Jitu/Jo					son a	and S	Sons ,
Sam	ole	Key: 🛛	SPT 🛮 Shelby Tube 🗏 Disturbed	L C	D - Dry	/ Dens	eu con sity (pci	ηρ. 306 f)	ngui (iSi	"													

	4	~~~	a.i4	tod Tooting I about oning Inc						LO	G O	F B	0	RIN	G I	B-1	3		PAGE	1 OF 1	DA	TE			6/	/10/2013
	A	SSO	cıaı 3	ted Testing Laboratories, Inc. 1143 Yellowstone Blvd	PF	ROJECT	r: F	rop	osea	l Wa	ater Li 100033	ne R	epi	lacen	nent	in F	lamme	erly A	rea		SUI	RFAC	E ELE	EVAT		8.34
			I	Houston, Texas-77054	PF	ROJECT					00033			ING T	YPE:	Αι	ıger				(%)		ERBE			
				LOCATION	tot O	1,101,1			V (blov 40	ws/ft) 60	• 80	9	ŝ	ЭМР.	(%) N		Natu			Content	CONTENT (				PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
<u> </u>		USC	EVEL	Teague Rd. Northing: 13861203.18	0717	INT Not)	1	1.0	Q <sub>u</sub> (t	tsf) 3.0	4.0		3	VED C( H (tsf)	STRAII	G E (psi)		Atterbe	and erg Lim			TIMIT	C LIMI	II YTIO	#200 S	ED ANGLI
DEPTH (#.)	MFLEX	000	TERL	Easting: 3065460.05	POCKET	BLOW COUNT (N, Blows/Foot)	٤	<b>★</b> 90	DD () 100	pcf) 110	<b>★</b> 120	ORY DENSITY (pcf)		UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Co	isture ntent O— —	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	ESTIMATE INTERNAL OTHER TE
O DE	N. A.		W				1	<b>♦</b> 1.0	P (t: 2.0		<b>♦</b> 4.0	VAC	5	UNC	FAI	CON	20	40	_	80		LL	PL		PAS	EST INT OTF
				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5						•	•					0				9					
				with ferrous nodules below 2'	4.5						•	<b>.</b>					<b>♦</b> ⊢-	 			6	27	15	12	55	
- 5 -				very stiff with calcareous nodules below 4'	4.0				<b>A</b>		*	11	8	1.85		0					10					
		CL		hard below 6'	4.5						•	• • •					0				12					
					4.5						\$**** <b>\</b>	· · · ·					0				11					
- 10 - 					4.5						•	• · ·					<b>∳⊢</b> -				13	38	17	21	70	
				very stiff below 12'	3.25	i				•											. 11					
Water Water Dry Sampl	· Ob	serva	ations	Intial:  After Drilling  24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube		to Abb. N - SP P - Poo T - Toi Q <sub>u</sub> - Uni DD - Dry	T Data cket P rvane confin	a (Blo Penetr (psf) ed C	rometë omp. S	er (tst	,	A L		ered t						rilling. Di hn, QC/				son a	ınd S	

									LO	G OF	BC	PRIN	IG I	B-1	4		PAGE	1 OF 1	DA	TE			6/	10/2013
	F	Associai 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	Pl	ROJEC	т: Н	Prop	oose	d Wa	ater Lin	e Rej	olacen	nent	in H	lamme	erly Ai	rea		SUI	RFAC	E ELI	EVAT	ION	5. <i>79</i>
		I	Houston, Texas-77054	Pl	ROJEC					00035		r-3 RING T	YPE:	Au	ger				(%)		ERBI VITS(			
			LOCATION		P, ISI)		• 20	N (blo		<b>•</b> 80	e e	MP.	(%)		Natu			Content	→ .			_	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		SVEL	Moss Hill Dr.		1 E H ( VT 2t)		<b>A</b>	Q <sub>u</sub> ( 2.0	(tsf)	<b>A</b>	77 (pc	ED CC (tst)	TRAIN	(psi)		a Atterbe	ind erg Lim	its	CONTENT	IMIT	בוואוד:	NI YTI:	500 SI	D ANG FRICT
DEРТН (ft.)	SAMPLES	USC (31 H31	Northing: 13861133.19 Easting: 3066124.91	ET	PENETHOMETEH(P.187) BLOW COUNT (N. Blows/Foot)		+ 90	DD (	(pcf)	★ 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Col	sture ntent	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	ESTIMATE. INTERNAL OTHER TE
DEF	SAN	WA	MATERIAL DESCRIPTION	POCKI	SLOW N. BK		<b>♦</b>	P ( 2.0	tsf)	•	DRY	UNC	FAIL	CON	⊢ – 20	- — — → 40	⊖– – 60	– – -I 80	MOIS	ILL	PL	PI	PAS	EST INTE OTH
- 0	7	4 6	7" Concrete			1	: :			: : :					: :	: :	: :	: : :						
_	1		Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5	;					•					φ				14					
_	$\frac{1}{2}$		with calcareous nodules below 2'	4.5	;					•									12					
- 5	$\frac{1}{}$		with ferrous nodules below 4'	4.5											<b> </b>				10	36	17	19	70	
	$\frac{1}{2}$	CL		4.5	;					•					φ				12					
	$\frac{1}{\sqrt{2}}$		stiff below 8'	2.0				•							•				18					
- 10 ·	$\frac{1}{2}$			2.0				•							φ-				15	45	18	27	69	
			hard below 12'	4.5	;			•		* •	120	2.25		0					12					
																		<u></u>						
Dry	r O	bservations	ntial: ∑ After Drilling ₹ 24 Hrs: ₹ Initial Water Level: Dry, After Drilling Water Level:		/ to Abb N - SF P - Po T - To Q <sub>u</sub> - Un	PT Dat cket F rvane confir	ta (Bi Pene (psf ned (	llows/F etromet f) Comp.	t) ter (ts: Stren	f) gth (tsf)		gered t						illing. Di hn, QC/				son a	and S	Sons ,
Sam	ole i	Key: 🛛 S	SPT 🛮 Shelby Tube 🖺 Disturbed	I	DD - Dr	y Den	isity (	(pcf)																

		4	. ,							LO	G OF	BC	RIN	IG I	B-1	5		PAGE	1 OF 1	DA	TE			6/	11/2013
	F	Associ	ıat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	Pl	ROJECT	г: F	rope	osed	Wa	ter Lind 00035-	e Rep	olacer	nent	in H	lamr	nerl	y Area		SUI	RFAC	E ELI	EVAT		5.28
			H	Iouston, Texas-77054	PI	ROJECT					00035-		ring T	YPE:	Au	ger				(%)	1	ERBI MITS(			
				LOCATION	į	P,tsr)			V (blov 40	ws/ft) 60		)to	OMP.	(%) ^		Na	atural	Moisture	Content	→ .			_	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
_		USC	EVEL	Rosefield Dr.		ETER( NT ot)	1	<b>A</b>	Q <sub>u</sub> (t 2.0	sf)	<b>A</b>	) YT	ED CC 1 (tsf)	TRAIN	ج : (psi)			and erberg Lin		CONTENT	IMIT	C LIMIT	II YTIC	200 SI	D ANC FRIC: STS &
DEРТН (ft.)	SAMPLES	USC	TER LI	Northing: 13861106.34 Easting: 3066841.5	ET.	PENETHOMETEH(P.187) BLOW COUNT (N. Blows/Foot)		*	DD (p 100	ocf) 110	*	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plas Lim	nit	Moisture Content	Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING#	ESTIMATE INTERNAL OTHER TE
) DEF	SAN		WA	MATERIAL DESCRIPTION	POCKI	PENE BLOW (N, BK	1	<b>♦</b> 1.0	P (ts 2.0		<b>♦</b> 4.0	DRY	UNC	FAIL	CON	+ 	20	<i>− ← − 60</i>	•	MOIS	7 1L	PL	PI	PAS	EST INTE OTH
	И	4	N . K	_ 4.5" Concrete			:	: :	: :	: :						:	: :	: : :	: : :						
_	$\frac{1}{2}$			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.0					•						φι	1			12	34	16	18	62	
<u> </u>	$\frac{1}{\sqrt{1}}$			with calcareous nodules below 2'	3.5	;					• • • • • • • • • • • • • • • • • • • •									12					
- 5	$\frac{1}{\sqrt{1}}$	CL		stiff with ferrous nodules below 4'	2.0	)			•	*		114	0.55		0	-				15					
	$\frac{1}{\sqrt{1}}$				2.0	,			•								)			17					
	$\frac{1}{\sqrt{1}}$	СН		Sandy Fat Clay (CH), very stiff, high plasticity, light gray and tan	3.5	;					• • • • • • • • • • • • • • • • • • • •						<b>)</b> ——			. 17	52	19	33	68	
- 10 ·	$\frac{1}{\sqrt{1}}$	СН		with calcareous nodules below 10'	4.0	)					*	122	1.55		0		)			17					
				with ferrous nodules below 12'	4.0						•					6	)			16					
Wate				ntial: ☑ After Drilling.▼ 24 Hrs: ▼	Kej	to Abb	reviati	ions:				Note													
Dry				Initial Water Level: Dry, After Drilling Water Level:		N - SP P - Po T - Tol Q <sub>y</sub> - Un	rvane confin	(pst) ed Co	отр. S	r) er (tsf, Streng	gth (tsf)								Prilling. Di ohn, QC/				son a	and S	Sons ,
Samp	ole i	Key:	$\triangle$ S	PT $\square$ Shelby Tube $\square$ Disturbed	ı	DD - Dry	/ vens	ыту (р	ICT)			1													

		ممما		ted Testing Laboratories Inc						LC	G O	FE	30	RIN	G I	B-1	6		PAGE	1 OF 1	DA	TE			6/	/20/2013
	Α	1550	ciai 3	ted Testing Laboratories, Inc. 1143 Yellowstone Blvd	PI	ROJEC	T: <b>F</b>	Prop	ose	d Wa	ater Li 00003:	ne F	Rep	lacen	nent	in H	lamr	nerly	Area		SUI	RFAC	E ELI	EVAT		4.93
			I	Houston, Texas-77054	Pi	ROJEC					,0003			.s RING TY	YPE:	Au	ger				(%)		ERBE //ITS(			
				LOCATION	į	(P,tst)	2	• 1 20	N (blc 40	ows/ft) 60			(bct)	ЭМР.	(%) N		Na	tural N	Noisture (	Content	CONTENT (		7	NDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (%, OTHER TESTS & REMARKS
(; )		USC	EVEL	Moorberry Ln.		IF I E H	. 1	1.0	Q <sub>u</sub> (	(tsf) 3.0	<b>4</b> .0		σ) YT!	JED CC 4 (tsf)	STRAII	G E (psi)			and rberg Lim			LIMIT	C LIMI	UTY II	#200 S	ED ANGL. FRICTIC
DEPTH (#.)	SAMPLES	000	TERL	Northing: 13861195.81 Easting: 3067484.34	(ET	PENETHOMETEH(P,tst) BLOW COUNT (N. Blows/Foot)		<b>★</b> 90	DD 100	(pcf) 110	<b>★</b> 120		DRY DENSITY	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plas Lim	tic M it (	Moisture Content >	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	ESTIMATE INTERNAL OTHER TE
0 DE	SA		W	MATERIAL DESCRIPTION	POCKI	BLOV N. BI	. 1	<b>♦</b> 1.0	P ( 2.0		<b>♦</b> 4.0	i	DRY	UNC	FAI	CON		20 4	10 60	 80	MOK	LL	PL	PI	PAS	ES1 INT, OTH
	4	1		5" Concrete Sandy Lean Clay (CL), hard, medium	4.5												:				11	32	16	16	69	
				plasticity, light gray and tan							•	•					φH	1								
				with calcareous nodules below 2'	4.5	5															10					
	$\parallel$																T T									
				with ferrous nodules below 4'	4.5	5															12					
- 5 -	$\parallel$										•															
-					4.5	5															13					
	$\parallel$	CL					;				•	•					ф				-					
					4.5	5	<u>;</u>														12	43	18	25		
											•	•					фі		4							
- 10 -				very stiff below 10'	4.0	,						1	18	1.9		0					15					
<u> </u>	$\parallel$								<b>A</b>		**						•				-					
					4.0	,	;   										;.				16					
	$\parallel$	E															ф.				-					
	Н						:	i j.										<u> </u>		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-					
Water	16	evel		Intial: ☑ After Drilling.▼ 24 Hrs: ▼	Ke	y to Abb	reviati	ions:				N	lotes	): ::												
				: Initial Water Level: Dry, After Drilling Water Level:		N - SF P - Pc	PT Data	a (Blo Peneti	ows/F rome	t) ter (ts	f)	/	Aug	ered to						rilling. Dr hn, QC/				son a	and S	Sons ,
Samp	le l	Kev:	$\boxtimes$ 8	SPT 🛮 Shelby Tube 🗏 Disturbed		Q - Ur DD- Dr	confin V Dens	ed C sity (r	comp.	Stren	gth (tsf	)	٥.	-				,		-		-				

	4		•							LC	OG O	F B	ORIN	١G	ìВ-	17	7	PAGE	1 OF 1	DA	TE			6/	12/2013
	A	SSOC	ciat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	T: I	Prop	DOSE	ed W	ater Lir	ne Re	place	me	ent in	Ha	amme	rly Area		SU	RFAC	E ELI	EVAT	ION	4.51
			I	Houston, Texas-77054	PR	OJEC:					000035		U-3 DRING T	TYP	PE: /	٩u٥	ger			(%)		ERBI MITS(			
				LOCATION	D, tsf)			• 20	N (bi		(t) • 80	u u	MP.	,	(%)	T	Natura	al Moisture (	Content					EVE (%	iLE OF TON (°,
			EVEL	Eaglerock Dr.	ETER(I	£ 47		<b>A</b>	. Q,	, (tsf)	<b>A</b> 0 4.0	) Y	ED CO		TRAIN	(isd)	A	and Atterberg Lim	nits	CONTENT	TIMI	LIMIT	NI YTI:	200 SII	D ANG FRICT STS &
DEPTH (#.)		USC	TER LE	Northing: 13861345.15 Easting: 3068035.36	ET TROMI	BLOW COUNT (N, Blows/Foot)		+ 90	DD	(pcf)	<del>*</del>	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	i i	FAILURE STRAIN (%) CONFINING	SSURE	Plastic Limit	Moisture Content	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (%). OTHER TESTS & REMARKS
DEF	ָבָּלָ ס		WA	MATERIAL DESCRIPTION	POCKET PENETR	BLOW (N, BK		<b>♦</b> 1.0	Р	(tsf)	<b>4.0</b>	DRY	UNC	į	CON	PRE	+ − · 20		— <b></b> 1	MOIS	LL	PL	PI	PAS	EST INTE OTH
	7	7		7" Concrete				: :	: :	1 1															
	7			Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.0					•							φ	-1		16	44	18	26	63	
					2.5											ŀ				16					
										•															
- 5 -	/ '	CL		with ferrous nodules below 4'	3.5						•									13					
				hard with calcareous nodules below 6'	4.5				•		* •	120	2.25		0	)	0			14					
				Sandy Fat Clay (CH), very stiff, high plasticity, light gray and tan	3.5						•						φ⊩-			15	54	19	35	69	
- 10 -				with calcareous nodules below 10'	4.0											ŀ				22					
		СН									<b>→</b>														
					4.0			<b>A</b>		*	•	108	0.83		S	}				20					
									: :										iii						
Water Water Dry Sampl	Obs	serva	tions	ntial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube   Disturbed	N P	to Abb I - SF P - Po - To O - Un	PT Dai ocket l	ta (B Pene	lows/ etrome	eter (te	sf) ngth (tsf)		ıgered					ted after Di By: Jitu/Jo					son a	and S	Sons ,

HOLOE								L	OG O	FΒ	ORII	٧G	<b>B-</b> 1	18	PAGE	1 OF 1	DA	TE			7/	09/2013
	ASS	oci	3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PRO	OJEC	T: Prop	osed N	Nater Li S-00003:	ne Re	eplace	mer	nt in I	Hamme	erly Area		SUI	RFAC	CE ELI	EVAT		3.44
			H	Iouston, Texas-77054	PRO	OJEC	TNO.: C				ORING	TYPE	: A	uger			(%)		TERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (%). OTHER TESTS & REMARKS
				LOCATION	R(P,tsf)		20	N (blows 40 6	80	cf)	OMP.	(%) N			ral Moisture (	Content	➡ .		7	NDEX	PASSING #200 SIEVE (%)	GLE OI TION ( & REM.
t.)	y US	SC	>	Lexford Ln. Northing: 13861462.56	<i>NETER</i>	JNT oot)	1.0	2.0 3	.0 4.0	SITY (p	VED C	STRAI	G (G (DSi)		Atterberg Lin		E CON	LIMIT	C LIM	CITY I	#200 S	ED AN L FRIC ESTS
DEPTH (#.)	SAMPLES			Easting: 3068486.85	KET ETROM	BLOW COUNT (N, Blows/Foot)	90		10 120	DRY DENSITY (pcf)	UNCONFINED COMP.	FAILURE STRAIN (%	CONFINING	Plastic Limit ⊢ –	Moisture Content — — ← —	Liguid Limit —— -	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SSING	TIMAT. FERNA HER T
P DE	A A		×	MATERIAL DESCRIPTION	POCKET PENETE	BLOV (N, B.	1.0	P (tsf) 2.0 3		DR)	UNC	FA	COI	20	40 60	80	MO	LL		PI	PAS	ES' INT OT
	И	7/		7" Concrete				: :						: :		: : :			4.5			
-	/			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.0									<b>Q</b>	4		14	29	15	14	51	
	7			with calcareous and ferrous nodules below 2'	3.0												14					
-	Ц				3.5												14					
- 5 -	CL				0.0				•								' '					
				stiff with sand seam below 6'	2.0												11	25	15	10		
	Ц				2.0					10	0 00		0	OF-1			12					
-	/				2.0		<b>A</b>		*	12	0.8						12					
- 10 -	M			Silty Sand (SM), medium dense, non plastic, light gray and tan		15											5					
-							7															
			✓			20	•										5					
- 15 -	SM			wet below 14'		25				_							24				16	
-						22											24					
	X					23	•							 			24					
<u></u>	Щ.,		Ц	46 2 9	1/					1												
Water N/A			ons:	ntial: ♀ After Drilling▼ 24 Hrs: ▼ Initial Water Level: 14', After Drilling Water Level:	N P	- SP - Po	reviations: T Data (Bl cket Penei rvane (psf, confined ( y Density (	lows/Ft) trometer	(tsf) rength (tsf,	A					ed at 12.5', ed BY: PV,							
Samp	le Key:	· [2	$\leq s$	PT 🛮 Shelby Tube 🖺 Disturbed	D	D - Dry	y Density (	pcf)														

		4		4. I Tanking I also make visus I as			LOG OF	= BC	ORIN	IG B-	19	PAC	E 1 OF 1	DA	TE			7/	11/2013
	Α	1550	Ĵ	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJEC	CT: Proposed Water Lin WBS No. S-000035	e Rej	olacen	nent in	Han	mmerly Area		SUI	RFAC	E EL	EVAT		3.47
			1	Houston, Texas-77054	PRO	OJEC	OT NO.: G13-164			YPE: A	uge	er		(%)		ERBI MITS(		(%	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● N (blows/ft) ● 20 40 60 80	ct)	OMP.	(%) N		Natural Moistur	e Content	CONTENT (		7	VDEX	PASSING #200 SIEVE (%)	3LE OI TION ( & REM.
(		US	EVEL	Hammerly Blvd.	ETER(	NT ot)	<b>▲</b> () (tsf) <b>▲</b>	g) YT!	ED CC 1 (tsf)	STRAII	(ISd)	and Atterberg L	imits		IMIT	CLIMIT	II XIIC	200 S	D ANG FRIC STS 8
DEРТН (#.)	SAMPLES	USI	Z TER LI	Northing: 13860623.48 Easting: 3064340.91	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	* DD (pcf) * 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN CONFINING	PI L	lastic Moistur imit Conten	t Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	# SING	IMATE ERNAL IER TE
o DEF	SAN		WA	MATERIAL DESCRIPTION	POCKE. PENETF	BLOW (N, Bk	↑ P (tsf) ↑ 1.0 2.0 3.0 4.0	DRY	UNC	FAIL	THE THE	<u>20 40 6</u>	I 0 80	MOIS	7 LL	PL	PI	PAS	EST INTE OTh
- U	П		P 6	6" Concrete							:								
-	$\sqrt{}$			Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	2.0		<b>\</b>				;	<b>₽-</b>		17	40	17	23	52	
	$\dagger$			very stiff with vertical sand seam below 2'	3.0									18					
-	$\mathbb{I}$																		
- <i>5</i>	]				3.0									15					
		CL		with ferrous nodules below 6'	3.0							Ø		15	45	18	27		
- -				hard below 8'	4.5		<b>A</b> • • •	121	2.25	0		9		14					
- 10 - -		SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		22 21	•				ф Ф			8				23	
_	<u>-</u> <u>\</u>										<u>ф</u>								
Dry	er Ol	bserv	ations	Intial: \(\to \) After Drilling\(\textbf{T}\) 24 Hrs: \(\textbf{T}\) : Initial Water Level: Dry, After Drilling Water Level:  SPT \( \begin{align*} \Begin{align*} Shelby Tube  \Beta \) Disturbed	N P T Q	- SF - Po - To: Un: - Un	breviations: PT Data (Blows/Ft) ocket Penetrometer (tsf) orvane (psf) nconfined Comp. Strength (tsf) rv Densitv (pcf)		gered t			e Grouted afte cked By: Jitu/					nnsoi	n and	l Sons ,

		1 ~~ ~		to d Toating I about oning Inc.			LOG OF	BC	PIN	IG E	3-2	0	PAGE	1 OF 1	DA	TE			7/	11/2013
	F	1550		ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJEC	T: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent i	'n F	łammerly	Area		SUI	RFAC	E ELI	EVAT		3.34
			Ì	Houston, Texas-77054	PRO	OJEC	T NO.: G13-164		r-3 RING T	YPE:	Αι	ıger			(%)		ERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	OMP.	(%) N		Natural I	Moisture C	Content	CONTENT (		7	VDEX	PASSING #200 SIEVE (%)	3LE OI TION ( & REM,
·		US	EVEL	Hammerly Blvd.	ETER	NT ot)	▲ O (tsf) ▲	d) YT!	IED CO	STRAII	= (psi)	Atte	and erberg Limi			LIMIT	C LIMI	II YTIC	£200 S	ED ANG FRIC
DEРТН (ft.)	SAMPLES	030	TERL	Northing: 13860645.28 Easting: 3064907.36	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	PRESSURE (	Plastic Limit	Moisture Content —	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	IMATE ERNAL IER TE
o DE	SAI		W	MATERIAL DESCRIPTION	POCKE PENETF	BLOV (N, Bl	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DRY	UNC	FAII	PRE	20	40 60	80 80	MOR	LL	PL	PI	PAS	ES7 INT <sub>1</sub>
	И			6.5" Concrete																
_	$\frac{1}{2}$			Sandy Lean Clay (CL), firm, high plasticity, light gray and tan	1.0		•					φ			15					
Ĺ	$\dagger$			very stiff with ferrous nodules below 2'	2.5										16	38	17	21	51	
- - 5					3.0							0			16					
_		CL		with sand seam below 6'	<i>3.75</i>		•					Φ			14					
- -					4.25		<b>* *</b>	113	1.9		0	0			17					
- 10 -	<del>-</del>			stiff below 10'	2.0		•					<b>\$</b> -1			17	31	16	15		
_	<u></u>	SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		14	•								9					
Dry	er O	bserv	ations	Intial:   After Drilling  24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:  SPT   Shelby Tube   Disturbed	N P T Q	- SF - Po - To ), - Un	previations: PT Data (Blows/Ft) pocket Penetrometer (tsf) provane (psf) proonfined Comp. Strength (tsf) by Density (pcf)		gered t			Hole Grout Thecked By						nnsoi	n and	l Sons ,

		ممما	a <b>:</b>	tod Tostino I abountarios Inc			LOG OF	BC	RIN	G B	-2	<b>1</b> PAGE 1 OF 1	DAT	TE			7/	11/2013
	P.	1550	ciai 3	ted Testing Laboratories, Inc. 1143 Yellowstone Blvd	PRO	DJECT	T: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent ir	ı H	łammerly Area	SUF	RFAC	E ELE	EVAT		7.19
			1	Houston, Texas-77054	PRO	DJECT	TNO.: G13-164		r-3 RING T	YPE: .	Au	ıger	(%)		ERBE			ESTIMATED ANGLE OF INTERNAL FRICTION (%), OTHER TESTS & REMARKS
				LOCATION	P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	cf)	OMP.	(%) ^		Natural Moisture Content			7	VDEX	EVE (	3LE OI TION ( REM.
		1100	EVEL	Hammerly Blvd.	ETER(	ot)	<b>A</b> O (tsf) <b>A</b>	TY (pa	ED CC I (tsf)	TRAII	(bsi)	and Atterberg Limits	CONTENT	IMIT	C LIMI	II YTI	200 S	D ANC FRIC
DEРТН (ft.)	SAMPLES	USC	TERLI	Northing: 13860666.01 Easting: 3065419.57	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	PRESSURE (	Plastic Moisture Liquid Limit Content Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	IMATE ERNAL ER TE
o DEF	SAN		M	MATERIAL DESCRIPTION	POCKE: PENETF	BLOW (N, Blc	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DRY	UNC	FAIL	PRES		MOIS	IL.	PL PL	Id PI	PAS	EST, INTE OTH
- 0	$\mathbb{Z}$	9		6" Concrete														
-	$\frac{1}{2}$			Lean Clay (CL), very stiff, high plasticity, light gray and tan	4.0		•					₽÷÷→	21	49	19	30	90	
-	$\dagger$				3.0								22					
-	-						•					<b>•</b>						
_	$\dagger$			with ferrous nodules below 4'	3.5								20					
- 5	$\parallel$						•				ŀ							
	$ \uparrow $			with calcareous nodules below 6'	4.0								17					
		CL										9						
					2.5								27					
- 10	$\prod$											<i>J</i>						
-				stiff below 10'	2.0		<b>▲</b> ◆ ★	114	0.75		0	<i>,</i>	18	29	15	14		
-	$\prod_{i=1}^{n}$			very stiff below 12'	3.0								17					
-	$\frac{1}{2}$			very Still below 12	3.0		•											
	+																	
Wate Wate Dry				Intial: ☑ After Drilling. ☑ 24 Hrs: ☑ : Initial Water Level: Dry, After Drilling Water Level:	N P	- SP - Po	oreviations: PT Data (Blows/Ft) cket Penetrometer (tsf) rvane (psf)		gered t			le Grouted after Drilling. Di hecked By: Jitu/John, QC/				son a	and S	Sons ,
San	nle l	Kev:	$\boxtimes$ s	SPT 🛮 Shelby Tube 🖺 Disturbed	Q Di	, - Un D- Dry	rvane (psf) confined Comp. Strength (tsf) y Density (pcf)											

								LC	OG OF	BC	ORIN	IG I	B-2	2	PAGE	1 OF 1	DAT	ΤΕ				11/2013
	F	Associa.	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PR	OJECT	: P	ropos	ed W	ater Lin	e Rej	placen	nent	in H	amme	rly Area		SUF	RFAC	E ELI	EVAT	ION	5. <i>63</i>
		Ì	Houston, Texas-77054	PR	OJECT				000035		1-3 RING T	YPE:	Au	ger			(%)		ERBI MITS(			
			LOCATION	fst o	(3)	2	N (1		t) • 80	b	MP.	(%)		Natur	al Moisture (	Content	→ .				EVE (%	ile of Ion (°, REMA
		USC 13	Hammerly Blvd.	TFB/	()tc	1	.0 2.0	$Q_{ij}$ (tsf)	<b>A</b>	77 (pc	ED CC (tst)	TRAIN	(psi)	A	and Atterberg Lim	nits	CONTENT	IMIT	LIMIT:	ITY IN	300 SI	D ANG FRICT STS &
DEРТН (ft.)	SAMPLES	USC H	Northing: 13860674.16 Easting: 3065858.06	ET	BLOW COUNT (N, Blows/Foot)	9	⋆ D	D (pcf)	* 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEF	SAN	MA	MATERIAL DESCRIPTION	POCKI	BLOW (N, Blo	1.		P (tsf)	<b>*</b>	DRY	UNC	FAIL	CON	+ − 20	 40 60	— — - <b>I</b> 80	MOIS	LL	PL	1	PASS	EST. INTE OTH
- 0	V	A 5	5.5" Concrete																			
<u> </u>	$\frac{1}{4}$		Sandy Fat Clay (CH), very stiff, high plasticity, light gray and tan	3.5					•					9			17					
-	$\frac{1}{2}$			2.5				•						0			17					
- - 5		СН	with ferrous nodules below 4'	3.0				•						•			18	50	19	31	70	
-	<u> </u>  -	CH CH	stiff, reddish brown below 6'	1.75			•							\	<b>\</b>		40					
-	$\frac{1}{\sqrt{1}}$		firm below 8'	1.0													29					
- 10 -	$\frac{1}{\sqrt{1}}$		Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan with sand seam	1.75			•							<b> </b>	<b>-</b>		20	37	17	20		
<del> </del>	1	CL		2.0		<b>A</b>	•		*	116	0.75		0	d			16					
Wate Wate Dry			Intial: ☑ After Drilling ▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level:	N F	to Abbi N - SP P - Poo T - Tor D - Unio	T Data cket Pe	a (Blows enetron	netér (t	sf) ngth (tsf)		gered i				ted after Di By: Jitu/Jo					son a	and €	Sons ,
Sam	ole i	Key: 🛛	SPT 🛮 Shelby Tube 🖺 Disturbed	7	DD - Dry	Dens	ity (pcf)	ب. کررو )	g (131 <i>)</i>													

		1 004	ai ai	ted Testing Laboratories Inc						LO	G	OF	BO	OR	IN	G B	3-23	3 (F	Z-	1)	P	AGE	1 OF	1 D	4 <i>TE</i>			-6	6/18/2013
	A	ISSO	3	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	Pi	ROJE	ECT:	P.	)ropi	ose	d W	/ate	r Lin 1035-	e Re	epl	acen	nent	in H	amr	nerly	/ Are	за		St	JRFA	CE EL	EVA7		1 35.99
			I	Houston, Texas-77054	P	ROJE	ECT.	NO.:					,000-			ING TY	YPE:	Au	ger					(%)		TERB MITS		1	г <sup>9</sup> ), 4 <i>ВКS</i>
				LOCATION		PENETROMETER(P,tsf) BLOW COUNT				40	60	) 8		cf)	. !	OMP.	(%) N		Na	ıtural	Moist an		Content	_		7	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
) t		US	EVEL	Hammerly Blvd. Northing: 13860566.54		1ETER INT	oot)	1	1.0	2.0	(tsf) 3.0	) 4	1.0	D) YTIS	: !	VED C H (tsf)	STRAI	G E (psi)			erberg	g Limi				C LIMI	CITY I	#200 S	ED ANGLI
DEPTH (ft.)	MFLE	00.	TERL	Easting: 3066377.93	(ET	V COL	ows/Fc		90	100	110	) <b>*</b> 0 1.	20	DRY DENSITY (pcf)		UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plas Lim	tic iit	Moisi Cont	tent	Liqu Lim — — -	id it WOISTURE	LIQUID LIMIT	PLASTIC LIMIT	LASTI	SING,	ESTIMATI INTERNA OTHER T
O DE	Š		W	MATERIAL DESCRIPTION	POCKI	PENE BLOV	(N, BI		<b>♦</b> 1.0		(tsf) 3.0	) 4	<b>♦</b> !.0	DRY		STR	FAI	CON	<u></u>	20	40	60	80	ÖM	LL			PAS	ES7 INT, OTH
	4		7 S	8" Concrete						:		:							:										
† †	<u> </u>			4" Crushed limestone Sandy Lean Clay (CL), very stiff, high	3.0	2													а	<u>.</u>				18	3 45	18	27	67	
}	H			plasticity, light gray and tanwith calcareous nodules below 2'	4.0	2	.				·														7				
<u> </u>				war calcaredas ricades below 2									•							)									
	Ц	CL																	:										
_	1			with ferrous nodules below 4'	3.0	)																		17	7				
- 5 -	$/\!\!/$										•									)		:							
	1	CH		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.5	5																		18	3 61	21	40		
				piasticity, iigni gray and tan								•		-					•	<del> </del>	+-	-1							
	Н	СН		stiff with calcareous nodules below 8'	2.0	,								97	7	0.8		0		\					5 64	21	43		
	/			( slickensided )				•	<b>,</b> ,	· •										<b>-</b>	+-	<b>-</b> ⊣							
- 10 -	Ц						L		: :											1	<u> </u>								
	1			Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.0	)														L				18	3   49	19	30	70	
	/										Ĭ																		
Ī †	1	CL		hard below 12'	4.5	5																		20	7				
	$\parallel$												•							<b>&gt;</b>									
+ +	Н				4.5	5								10	9	1.39		10						2	,				
- 15	A				$\frac{1}{2}$		-				*		•							<u> </u>									
	Ш				上	$\perp$	$\perp$																						
Water Water	Ob	bserv	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:	Ke	N -	SPT	eviatio Data	a (Blo			ı - <b>(</b> )			tes: uge		o 15'	; PZ	wate	er lev	rel: C	1ry (6	/19/20	013);	<i>PZ</i> и	ater	level	: 12.	.5'
Dry, 24 Level:	4 h	nrs W	ater L	evel: Dry, 7 days Water Level: 12.5', 30 days Water		Т -	Torv	ket Pe vane ( onfine	(nsf)				(tcf)	(6	3/25	5/2013	3); I	PZ w	ater	level	l: 9' (	7/30/		Drille					, Logged By:
Sampl			$\mathbb{N}$	SPT 🛮 Shelby Tube 🖺 Disturbed		DD-	Dry	oniine Densi	sity (r.	orrip. ocf)	Sue	rigin	(181)		ν,	Unec	neu .	<i>ن y.</i> ن	itu/J	JIIII,	QU/1		у. го	'					

									LO	G C	)F	BC	RIN	G E	3-2	4	ŀ	PAGE	1 OF 1	DAT	Έ			6/	20/2013
	F	Associai E	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PR	OJECT	r: F	Prop	osec	d Wa	ater L 10003	ine	Rep	lacen	nent	in H	amme	rly Ar	ea		SUF	RFAC	E ELE	EVAT	ION	5.39
		1	Houston, Texas-77054	PR	OJECT					10003			-3 RING T	YPE:	Au	ger				(%)		ERBE			
			LOCATION	D tef	(S)			V (blo 40		• 80		(Jc	JMP.	(%) /		Natur			Content	→ .			_	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		USC 13A31	Moorberry Ln.	1 17 17 17 17 18 18 18 18 18 18 18 18 18 18 18 18 18	NT (to	1	<b>A</b>	Q,, (	(tsf)	<b>▲</b> 4.0		TY (pc	ED CC I (tsf)	TRAIN	; (psi)	,	a. Atterbe	nd rg Lim	its	CONTENT	-IMIT	CIMI	AI YTI	200 SI	D ANC FRIC
DEРТН (#.)	SAMPLES	USC STREET	Northing: 13860722.37 Easting: 3067075.01	ET TROM	BLOW COUNT (N, Blows/Foot)		*	DD (	(pcf)	<b>★</b> 120		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Cor	sture ntent	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	# SING	ESTIMATE INTERNAL OTHER TE
DEF	SAN	W	MATERIAL DESCRIPTION	POCKI	BLOW (N, Bk	1	<b>♦</b> 1.0	P (t 2.0		<b>♦</b> 4.0		DRY	UNC	FAIL	CON	⊢ – 20	← 40	.)— — . 60	– – - <b>I</b> 80	MOIS	7 LL	PL	PI	PAS	EST INTE OTH
_ 0 .	И	4	5.5" Concrete			:	: :	: :	:	: :	:					: :	: :	: :	: : :						
	$\frac{1}{\sqrt{1}}$		Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	4.0						•						9				12					
- ·    - ·			with calcareous nodules below 2'	3.5						<b></b>						<b>b</b> -				16	35	16	19	70	
- 5		CL	with ferrous nodules below 4'	3.0					•											17					
			with sand seam below 6'	3.0					•							•				19					
			stiff below 8'	2.0		<b>A</b>			*			111	0.65		0	$\phi$				16					
- 10 ·		СН	Fat Clay with Sand (CH), stiff, very high plasticity, light gray and tan with calcareous nodules	2.0				•								F			4	26	74	23	51		
			Intial: ☑ After Drilling.▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level:		to Abb N - SP		a (Blo			f)			gered t						illing. Di				son a	and S	Sons ,
Dry Sami	ole i	Key: 🛛 :	SPT 🛮 Shelby Tube 🖺 Disturbed		T - Toi Q <sub>u</sub> - Un DD- Dry	rvane confin	(psf) ned C	omp.	•	′		Log	iged B	Y: P\	/, C	hecked	By: J	itu/Jo	hn, QC/	QA E	By: P	ST			

				OD. GDT SIGN						LC	G OF	BC	PIN	IG	B-2	25	P	AGE	1 OF 1	DA	TE			6/	14/2013
	As	SSOC	iat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	CT:	Pro	pose	d W	ater Lin	e Rej	olacer	nen	t in F	lamm	erly Are	ea		SUI	RFAC	E ELI	EVAT	ION	4.59
			_	Houston, Texas-77054	PR	OJEC	CT N	WB '0.:			000035-		)-3 RING T	YPE	: Aı	ıaer						ERBI			
			П	LOCATION					N (bl	lows/ft	·) •						ural Mois	ture C	Content	NT (%)	LII	MITS(	_	VE (%)	E OF ON (°), 3EMAF
			EL.	Eaglerock Dr.	TER(P.			20 A		(tsf)		Y (pcf)	CON tsf)	RAIN (	(isa		ar Atterber	nd		CONTENT		-IMIT	LY INE	O SIE	ANGL RICTK TS & F
DEPTH (ft.)	3 6	JSC	ER LEV	Northing: 13860865.45 Easting: 3067622.03	T ROMET	BLOW COUNT	) 	*	r DD	(pcf)		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (	Plasti Limit	c Mois	ture	Liquid Limit		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEPTH (ft.			WATE	MATERIAL DESCRIPTION	<i>POCKET</i> PENETE	MO7	, <u> </u>	<u>90</u> ♦	Р	(tsf)	120 •	DRY D	UNCO	FAILU	CONF	<b>⊢</b> -	€		1	MOISTURE	DI LL		PI	PASSI	ESTIN INTEF OTHE
F 0 }	+	20	· is	6.5" Concrete	Д	<u> </u>	-	1.0	2.0	3.0	4.0				+ -	20	9 40	60	80		LL	FL		_	
				Sandy Lean Clay (CL), hard, high plasticity, light gray and tan	4.5						•					φ				15					
					4.5						•					o <del>l</del>				15	47	18	29	69	
	7			with calcareous nodules below 4'	4.5															11					
- <i>5</i> - 		X.		with ferrous nodules below 6'	4.5						•					Φ				13					
		,			4.5						•					<b>0</b> F				12	42	18	24	67	
- 10 <del>-</del> 				very stiff below 10'	4.0				<b>A</b>		*	118	1.7		0	0				15					
				hard below 12'	4.5						**	122	4.46		9					15					
-									ii	.ii	. i i i					1	111		111						
Dry	Obs	ervat	ions:	ntial:   After Drilling  24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:	١	1 - Si	PT L ocke	viations Data (E et Pene ne (ps nfined	Blows/letrome	eter (to	sf) ngth (tsf)		gered i						rilling. Di hn, QC/				son a	and S	Sons ,
Sampl	e Ke	y:	$\mathbb{N}$ S	SPT 🛮 Shelby Tube 🗏 Disturbed		D-D	ry D	ensity	(pcf)			1													

		4	•	4-1T-4in-I-l-material						L	.00	G OF	= B(	DRIN	١G	B-	2	ĵ	PAGE	1 OF 1	DA	TE			7/	09/2013
	F	4 <i>SSO</i>	3	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PR	OJEC:	T:	Pro	pos SS N	sed l	Wat	ter Lin 20035	e Re	olacei 1₋3	me	ent in	Н	ammer	ly Area		SU	RFAC	E ELI	EVAT		1.49
			1	Houston, Texas-77054	PR	OJEC	TNC					70000		RING 1	TYP	PE: /	٩u	ger			(%)		ERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)			• 20	40	blows	60 <sup>°</sup>	80	oct)	OMP.	( /0/ 14	(%) N		Natura	al Moisture C and	Content	CONTENT (		7.	NDEX	IEVE (	GLE OI TION ( & REM
ft.)	S	US	C	Lexford Ln. Northing: 13861081.23	METER	UNT 'oot)	<u> </u>	1.0	2.0	Q <sub>u</sub> (ts: 0 3	3.0	4.0	SITY (p	NED C		STRAI IG	R (psi)		tterberg Lim			LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	#200 S	ED AN L FRIC ESTS
DEРТН (#.)	SAMPLES		ATER	Easting: 3068178.41	POCKET PENETROI	BLOW COUNT (N, Blows/Foot)		90 ◆	10	D (po 0 1 P (tsf	10		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	9	FAILURE STRAIN (%) CONFINING	ESSUF	Plastic Limit ⊢ – -	Moisture Content 	Liquid Limit — — - <b>I</b>	MOISTURE	LIQUID LIMIT	PLAST	PLAST	PASSING #200 SIEVE (%)	STIMAT TERNA THER T
20	S		2	MATERIAL DESCRIPTION	POC PEN	BLO (N, E	,	1.0		0 3			DR	UN	ì	Z 0	PR	20	40 60	80	MC	LL	PL	PI	PA	
  -  -				5.5" Concrete  Fat Clay with Sand (CH), stiff, high plasticity, dark gray	2.0				•									Φ			21	51	19	32	<i>79</i>	
- - 5		СН		very stiff, light gray and tan below 4'	2.5					•											20					
- -				with calcareous nodules below 6'	2.5													0			19					
-				Lean Clay with Sand (CL), very stiff, high plasticity, light gray and tan	4.0				<b>A</b>		*	•	113	1.55		(	)	<b>b</b> -			20	46	18	28		
- 10 -		CL			3.5						•	•						<b>0</b> -	-1		17	39	17	22	81	
- -				with ferrous nodules below 12'	4.0							•						0			17					
Dry	er O		ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  SPT    Shelby Tube    Disturbed	N P	to Abb I - SF I - Po I - To I - Un	PT Da ocket	ata (E Pene	Blows etron	neter	(tsf) treng	nth (tsf)		gered					ed after Di By: Jitu/Jo					son a	and S	Sons ,

		ممما		ted Testing Laboratories Inc							LO	GC	)F	BC	RIN	IG	B-2	27		PAGE	1 OF 1	DA	TE			7/	19/2013
	Α	1550	ciai 3	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PI	ROJE	CT:	P	ropo	sea	l Wa	ater L	ine	Rep	lacen	nent	in F	lan	nmerly A	Area		SUI	RFAC	E ELI	EVAT		9.30
			I	Houston, Texas-77054	PI	ROJE	CT					0000	55-0		-3 RING T	YPE:	Αι	ıge	r			(%)		ERBI MITS(			
	T			LOCATION	į	P,tst)			D N	' (blov 40	ws/ft) 60	80		ct)	ЭМР.	(%) N		,	Natural Mo		Content	CONTENT (				PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
$\overline{}$		USC	EVEL	•		E I E H	ot)		.0 2	Q <sub>u</sub> (1 2.0	tsf) 3.0	4.0		) YT!	IED CC 4 (tsf)	STRAII	3 = (psi)		Atterb	and erg Lim			LIMIT	C LIMI	II YTIC	£200 S	ED ANGL. FRICTIC
DEPTH (ft.)	SAMPLES	030	TERL	Northing: 13860239.38 Easting: 3064598.53	(ET	PENETHOMETEH(P,tst) BLOW COUNT	ows/Fc		*	DD (f 100	pcf) 110	<b>★</b> 120		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Pla L	astic M imit C	oisture ontent >	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING#	ESTIMATE INTERNAL OTHER TE
o DEI	SAI		W	MATERIAL DESCRIPTION	POCKI	BLON	(N, Bk	1.		P (t: 2.0	sf) 3.0	<b>♦</b> 4.0		DRY	UNC	FAII	CON		20 40	•	1 80	MOIS	IL	PL		PAS	EST INTI OTH
- -		=		5.5" Concrete Sandy Lean Clay (CL), very stiff, slight plasticity, light gray and tan	4.0							•						9	) <b>⊢</b> I			10	23	15	8	51	
	Ħ			hard below 2'	4.5	5																10					
	<u> </u>				4.5	5							•	118	2.25		0		)			. 8					
- 5 -	_/									<b>A</b>		*	•					-									
		CL		with sand seam below 6'	4.5	5							•									9					
					4.5	5																11	35	16	19		
- 10 - 				stiff with ferrous nodules below 10'	1.7	5			•										6			17					
																		10									
Dry	r Ob	bserva	ations	Intial:   After Drilling 2 24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:		T - 1 Q L	SPT Pock Torv Unco	Data et Pe ane ( onfine	a (Blov enetro (psf) ed Co	metë mp. S	er (tst	f) gth (ts			jered t				Grouted a Jitu/Joh				Ву:	Van a	and S	Sons	, Logged
Samp	ile ł	Kev:	X S	SPT $\square$ Shelby Tube $\square$ Disturbed	I	DD- E	Dry I	Dens	ity (po	cf)		•	.														

		ا سما		ted Testine I about ories Inc			LOG OF	BC	PIN	IG B	-2	PAGE 1	OF 1	DAT	TE			7/	10/2013
	Α	1880		ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PR	OJECT	T: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent i	n F	Hammerly Area		SUF	RFAC	E ELI	EVAT		3.12
			Ī	Houston, Texas-77054	PR	OJECT	T NO.: G13-164		r-3 RING T	YPE:	Αι	uger		(%)		ERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	OMP.	(%) N		Natural Moisture Con	ntent	CONTENT (		7	VDEX	PASSING #200 SIEVE (%)	3LE OI TION ( & REM,
_		US	FVFI	Teague Rd.	ETER	NT ot)	<b>▲</b> () (tsf) <b>▲</b>	g) YT!	IED CC 1 (tsf)	STRAII	= (psi)	and Atterberg Limits			LIMIT	C LIMI	II YTIC	£200 S	ED ANG FRIC
DEРТН (ft.)	SAMPLES	03	TEBL	Northing: 13860179.08 Easting: 3065488.46	POCKET PENETROMETER(P.tst	BLOW COUNT (N, Blows/Foot)	★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	PRESSURE (	Plastic Moisture Limit Content L — — — ← — — — —	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	IMATE ERNAL IER TE
O DEI	SAI		AW	MATERIAL DESCRIPTION	POCKE. PENETF	BLON (N, Bk	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DRY	UNC	FAIL	PRE	20 40 60 8	— -I 80	MOR	7 LL	PL	PI	PAS	EST INTL OTH
	$\mathbb{I}$		4 4 4	10" Concrete															
┞				7" Stabilized soil with Lime															
-	$\mathcal{A}$			Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	2.0 2.75		<b>↑</b>					<b>□</b> ⊕ 1		16 17	26	15	11	51	
Ļ				very stiff with ferrous nodules below 2'			•							••					
	$\parallel$																		
ŀ	$\forall$			with sand seam below 4'	3.5									14					
- 5	-																		
ŀ	#	CL			3.5									14					
					0.0									17					
	$\parallel$																		
-	$\dagger$				3.5			117	1.15		0			16					
-	$\frac{1}{2}$						•					<b>.</b>							
- 10	Щ			5 . 0										40		40	00		
				Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	3.5									18	51	19	32		
	$\mathbb{I}$	СН																	
-	$\forall$			with ferrous nodules below 12'	3.0									27					
-	4				-								.ii						
Wate				l Intial: ♀ After Drilling.▼ 24 Hrs: ▼	Key	to Abb	previations:	Note		:				., :					
Wate Dry	er Ob	bserv	ations	s: Initial Water Level: Dry, After Drilling Water Level:	N P	' - Po	PT Data (Blows/Ft) ocket Penetrometer (tsf) orvane (psf)					ole Grouted after Drillin Checked By: Jitu/John					son a	and S	Sons ,
Sam	ole ł	Kev:		SPT  Shelby Tube	Ġ	) Un	nvarie (psr) nconfined Comp. Strength (tsf) ny Density (pcf)			,					•				

		1 000	ai a	ted Testing Laboratories Inc					LC	G OF	BC	RIN	IG I	B-2	9		PAGE	1 OF 1	DA	TE			7/	19/2013
	Α	1330		ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJEC <sup>*</sup>	:T: F	ropos VBS N	ed W	ater Lin 000035	e Rep	olacer 1-3	nent	in F	lamm	erly	Area		SUI	RFAC	E ELI	EVAT		6.25
			1	Houston, Texas-77054	PRO	OJEC:		G13				RING T	YPE:	Αι	ıger				(%)		ERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		1	N (1 20 40	60	80	oct)	ОМР.	N (%)		Nat	ural N	Noisture C and	Content	CONTENT		7	NDEX	IEVE (	GLE O TION ( & REM
f.)	S	US	C	Rosefield Dr. Northing: 13860188.06	METER	UNT oot)	3 1	.0 2.0	Q <sub>u</sub> (tsf) 0 3.0	4.0	SITY (p	NED C TH (tsf)	STRAI	IG RE (psi)	D(4)		rberg Lim			TIMIT	IC LIM	ICITY I	#200 S	ED AN L FRIC ESTS
DEРТН (#.)	SAMPLES		ATFRI	Easting: 3066243.52	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)		90 10	D (pcf) 0 110 P (tsf)		DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plasti Limit	t (	Moisture Content 	Liquid Limit — — -	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	TIMAT TERNA HER T
- 0	S	r	3	MATERIAL DESCRIPTION	POCKE PENETF	BLO (N, E	1		0 3.0		DR	NN TS	FA	CO P.B.	20	0 4	10 60	80	МО	LL	PL	PI	PA	ES N.
  - 	$\frac{1}{\sqrt{1}}$			5.5" Concrete Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	2.5				•						ф <del>-</del>				16	35	16	19	70	
- ·				with calcareous and ferrous nodules below 2'	2.75				•						φ				15					
- ·				stiff below 4'	2.0			•							<b>-</b>				16					
- ·		CL			1.5			•							0				17					
- ·				very stiff below 8'	2.5				•						<b>(</b>		4		17	44	18	26		
- 10 ·					3.5			<b>A</b>		•	114	1.25		0	0				17					
Wate				Intial: ♀ After Drilling.▼ 24 Hrs: ▼			breviati		(Fr)		Note													
Wate Dry Samp				s: Initial Water Level: Dry, After Drilling Water Level:  SPT  Shelby Tube  Disturbed	P T Q	- Po - To ), - Un	ocket P orvane nconfin	a (Blows enetron (psf) ed Com sity (pcf)	neter (ts np. Strei	sf) ngth (tsf)								rilling. Dr QA By: F		By:	Van a	and S	Sons	, Logged

				OD. GDT SIGN						L	.00	) OF	BC	RIN	IG	<b>B</b> -3	30		PA	GE	1 OF 1	DA	TE			6/	20/2013
	A	SSOC	iat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	CT:	Pro	opos	ed l	Wate	er Line	e Rep	olacer	nen	t in F	lan	nme	rly Are	а		SU	RFAC	E ELI	EVAT	ION	5.97
				Houston, Texas-77054	PR	OJEC	CT N					0035-		1-3 RING T	YPE	: Aı	uae	r						ERBI			SXE
			П	LOCATION					N (	blows	s/ft)				_		Ť		al Moisti	ıre C	Content	NT (%)	LII	MITS(	-	VE (%)	E OF ON (°), 3EMAF
			ÆL	Moorberry Ln.	TER(P,	L ~	_	20	<b>A</b> (	$Q_u$ (tst	60 f) ▲	<b>\</b>	Y (pcf)	D CON	RAIN (	(isa			and Atterberg	1		CONTENT	TIN	IMIT	TY INE	o SIE	ANGL FRICTION TS & F
DEPTH (ft.)	LES .	USC	ER LEV	Northing: 13860091.08 Easting: 3066531.9	7 ROME	BLOW COUNT	/s/F00t		⋆ D	D (pc	3.0 ★	7	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (	Pla Li	astic imit	Moist Conte	ıre	Liguia Limit		LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEPTH (ft.	SAM		WATE	MATERIAL DESCRIPTION	<i>POCKET</i> PENETE	LOW V. Blow	V, Blow	<u>90</u> ♦	I	P (tsf)		<u>120</u> ♦ 4.0	DRY D	UNCO	FAILU	CONF		<b>-</b>				MOISTURE	OJ7 LL	PL	PI	PASSI	ESTIN INTEF OTHE
- 0	$\dagger$	P4	15	8.25" Concrete	4	8 5		1.0	<i>)</i> 2.0	<u>0 3</u>	5.0	4.0					:	<u>20</u>	40	60	80						
				Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	4.0							<b>♦</b>					(	<b>₽⊢-</b>				13	44	18	26	67	
				with ferrous nodules below 2'	3.5																	15					
	4				4.0																	15					
- 5 - 												•						<b>-</b>		<u>:</u>							
	$\left  \right $				4.0							•						<b>\rightarrow</b>				16					
		CL		with calcareous nodules below 8'	3.5						* •		110	1.05		0						20					
- 10 -	4				3.5													$\frac{1}{2}$				27	48	18	30		
											•							<b>⊢</b> }	<b>&gt;</b>								
	$\left  \right $				4.0				•		*	•	116	1.63		9		\$				17					
	1				3.5						<b>*</b>							0				18					
- 15 -								· · ·		<u> </u>	:_							<del>:</del>	· · · · · ·	<u>:</u>	· · i · i ·						
Water Water Dry Sampl	OŁ	servatio	ons:	ntial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube	N P T G	to Abb - SF - Pc - Tc - Ur D- Dr	PT L Pocke orva Incor	Data ( et Per ane (pa nfinec	(Blows netron sf) d Com	netér np. Sti	(tsf) rengti	h (tsf)		gered							illing. D hn, QC				son a	and S	Sons ,

		4	. ,						L	OG.	OF	BC	RIN	IG	<b>B-</b> 3	81		PAGE	1 OF 1	DA	TE			7/	11/2013
	F	Assoc	ıat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PRO	OJEC	T: <b>F</b>	Propo	sed V	Nater	Line	Rep	olacer	nen	t in F	lamr	nerl	ly Area		SUI	RFAC	E ELI	EVAT	ION	5.35
			H	Iouston, Texas-77054	PRO	OJECT	V :TNO.:			6-0000 4	035-0		-3 RING T	YPE:	Αι	ıger				(%)		ERBI			
				LOCATION	P,tsf)					s/ft) •		(fi	JMP.	(%) /		Na	itura	l Moisture (	Content				-	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
			VEL	Hammerly Blvd.	ETER(	) (}c		<b>A</b>	Q,, (tsf	5) ▲ 8.0 4.0		od) YT	ED CC (tsf)	TRAIN	(psi)		At	and terberg Lim	its	CONTENT	IMIT	נואוד:	N YTI;	200 SI	D ANG FRICT STS &
DEPTH (#.)	SAMPLES	USC	FER LE	Northing: 13860250.25 Easting: 3066953.77	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)		* L	DD (pc	f) ★ 10 12		DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE	Plas Lim	tic it	Moisture Content	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	MATE: RNAL ER TE
	SAN		WA	MATERIAL DESCRIPTION	POCKE: PENETF	BLOW (N, Blo		<b>•</b>	P (tsf)	) <b>•</b>	•	DRY	UNC	FAIL	CON	+   2	— — 20	40 60	—	MOIS	17 LL	PL	PI	PASS	EST. INTE OTH
- 0		4	ž.	7" Concrete			:	: :	: :	: : :	:					:	: :	: : :	: : :						
-	1			Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	2.0			•	<b>.</b>								P			19					
	$\int$			very stiff with calcareous nodules below 2'	2.5															18	54	19	35	73	
_	$\prod_{i=1}^{n}$			with ferrous nodules below 4'	3.0															16					
- 5	$\frac{1}{2}$			with remous noddies below 4	5.0					<u> </u>							)			10					
- ·	$\frac{1}{2}$	СН			3.5					•						φ				16					
- ·	$\frac{1}{\sqrt{1}}$				4.0					•							<b>\</b>			21					
- 10 ·				stiff below 10'	2.0		_		<b>*</b>			108	0.85		0		•			21					
_ ·				Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.5												<b>-</b>	-1		17	43	18	25	69	
- - 15	1	CL		with calcareous nodules below 14'	4.0					•	<b>•</b>					d	)			18					
Dry	r O		ons:	ntial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  PT   Shelby Tube   Disturbed	N P T Q	- SF - Po - To: - Un	breviation  T Data  Docket Provane  Inconfine  Try Dens	a (Blov enetro (psf) ed Col	metér mp. Sti	(tsf) rength (	(tsf)		gered					ed after Di By: Jitu/Jo					son a	and S	Sons ,

	4	~~~~		od Togding I about towing Inc				LOG O	F B	ORIN	IG I	3-3	PAGE	1 OF 1	DA	TE			6,	14/2013
	A	SSOC	3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	T:	Proposed Water Li WBS No. S-000035	ne Re	eplacei	nent	in F	Hammerly Area		SUI	RFAC	E EL	EVAT		4.69
			E	Iouston, Texas-77054	PR	OJEC	TΛ	NO.: G13-164		DRING T	YPE:	Αι	uger		(%)		ERBI MITS(		(%)	r º), 4BKS
				LOCATION	(P.tsf)			● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	OMP.	(%) N		Natural Moisture Co	ontent	CONTENT (		7	NDEX	IEVE (	GLE OI TION ( & REM,
ft.)	0	USC	LEVEL	Eaglerock Dr. Northing: 13860430.51	METER	BLOW COUNT		<b>▲</b> $Q_u$ (tsf) <b>▲</b> 1.0 2.0 3.0 4.0	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	VG RE (psi)	and Atterberg Limit Plastic Moisture		E CON	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEPTH (#.)	SAIMPLES		'ATER	Easting: 3067247.63	POCKET PENETROI	W CO		★       DD (pcf)       ★         90       100       110       120         ♦       P (tsf)       ♦	Y DEN	CONFI	NLURE	CONFINING PRESSURE (	Limit Content	Liquid Limit - — - <b>I</b>	MOISTURE	LIQUIE	PLAST	PLAST	SSING	STIMAT TERNA THER T
0 2	ò		8	MATERIAL DESCRIPTION	POC PEN	BLO	7,	1.0 2.0 3.0 4.0	DR	NN ST	Į,	00 R	20 40 60	80	MC	LL	PL	PI	PA	
Ŭ	4	3	Z	5.75" Concrete	1															
				Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan	1.5								<b>₽</b>		20	46	18	28	70	
				very stiff below 2'	3.0										18					
  - 5 -		CL		with ferrous nodules below 4'	3.5								•		17					
				Sandy Fat Clay (CH), very stiff, high plasticity, ligh gray and tan with ferrous nodules	3.0										18	52	19	33	69	
				stiff below 8'	2.0				95	0.75		0			32					
 - 10 - 		СН		very stiff below 10'	3.0				99	0.82		8	9		27					
Water Water Dry Sampl	Ob	servati	ons:	ntial: ☑ After Drilling.▼ 24 Hrs: ▼ Initial Water Level: Dry, After Drilling Water Level: PT	F	I - SI Po To Q <sub>u</sub> - Ui	PT I ocke orva ncol	eviations: Data (Blows/Ft) ket Penetrometer (tsf) rane (psf) onfined Comp. Strength (tsf) Density (pcf)		ıgered			ole Grouted after Drii Checked By: Jitu/Joh					son a	and s	Sons ,

	,	1		ted Testing Laboratories Inc						L	OG	OF	BC	DRIN	IG	B-3	33		PA	GE	1 OF 1	DA	TE			7/	/09/2013
	Ε	1550	3	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	P	ROJEC	T:	Pro	pos se M	ed V	Vate	er Lin 2035-	e Rej	olacei	men	t in F	Han	nmeri	ly Area	а		SUI	RFAC	E EL	EVAT		4.66
			1	Houston, Texas-77054		ROJEC	T NO.					<i>,</i>		r-5 RING T	YPE	: Aı	uge	r				(%)		ERBI MITS(	%)	(%,	ال ر°), ARKS
				LOCATION		PENETHOMETEH(P,tst) BLOW COUNT (N Blows/Foot)		• 20	40		30	80	oct)	OMP.	(%) N			Natura	l Moistu and		ontent	CONTENT		1	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
t.)	ς <sub>0</sub>	US	C	Lexford Ln. Northing: 13860633.54		JNT Set		1.0	2.0	Q <sub>u</sub> (tsf) 0 3.	.0	4.0	3) YTIS	VED C H (tsf)	STRAI	G (psi)			terberg	Limi			LIMIT	C LIM	CITY	#200 S	ED AN L FRIC ESTS
DEРТН (ft.)	SAMPLES		) ATER L	Easting: 3067794.09	KET	N COL		90	100	D (pci	10 1	120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (	L	astic imit L – –	Moistu Conte	nt	Liquid Limit – — -l	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	LAST	SING	ESTIMAT. INTERNA OTHER T
0 PE	SA		M	MATERIAL DESCRIPTION	POCKI	BLOV BLOV	i E	<b>♦</b> 1.0		<sup>D</sup> (tsf) 0 3.		<b>◆</b> 4.0	OR	UNC	FAI	CON		20	_	60	80	MO	LL	PL		PAS	ES. INT OTI
   				6" Concrete Sandy Lean Clay (CL), very stiff, high plasticity, dark gray	4.0							<b>•</b>					(	}				12					
					3.5	5					•							0				16					
- 5 -	$\int$			gray and tan with ferrous nodules below 4'	3.0													<b>d</b> –	-1			15	37	17	20	70	
	$\int$	CL		light gray and tan with calcareous nodules below 6'	3.5	5					•							0				16					
					4.0							•	121	1.9		0	1	þ				13					
- 10 - 					3.5	5					•							Φ				15					
 		CIT		Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan with calcareous nodules	4.(							<b>♦</b>						<b>d-</b>	. —			17	50	19	31	85	
Water Water Dry Samp	r Ol	bserv	ations	Intial:   After Drilling 2 24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube Disturbed	'	y to Abl N - SF P - Po T - To Q <sub>u</sub> - Ur DD- Dr	PT Da ocket	ita (E Pene	Blows etrom	s/Ft) neter ( pp. Str	(tsf) rengtl	n (tsf)		gered							illing. Di hn, QC/				son a	and S	Sons ,

	,	1 999	aia	ted Testing Laboratories Inc			LOG OF	BC	PIN	IG B	-3	<b>PAGE 1 OF 1</b>	DA	TE			7/	/19/2013
	F	1330	Ĵ	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJEC	T: Proposed Water Line WBS No. S-000035-	e Rej	olacen 1-3	nent ir	ı H	lammerly Area	SUF	RFAC	E ELI	EVAT		3.62
			1	Houston, Texas-77054	PRO	OJEC	TNO.: G13-164			YPE:	Au	uger	(%)		TERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°). OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	cf)	OMP.	(%) N		Natural Moisture Content and	CONTENT		7	NDEX	PASSING #200 SIEVE (%)	GLE O TION ( & REM
f.)	S	US	EVEL	Elmgate Dr. Northing: 13860665.19	POCKET PENETROMETER(P,tsf	JNT oot)	$igaplus Q_u (tsf) \begin{tabular}{c cccc} $lackbox Q_u & (tsf) & \lackbox & 1.0 & 2.0 & 3.0 & 4.0 \end{tabular}$	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	E (psi)	Atterbera Limits		LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	#200 S	ED AN L FRIC ESTS
DEРТН (ft.)	SAMPLES		ATER L	Easting: 3068191.75	KET ETROM	BLOW COUNT (N, Blows/Foot)	* DD (pcf) * 90 100 110 120	r DEN	CONFI	ILURE	PRESSURE (	Plastic Moisture Liquid Limit Content Limit	MOISTURE	LIQUID LIMIT	LAST	LAST	SSING	TIMAT TERNA HER T
- 0E	SA		Ž	MATERIAL DESCRIPTION	POC. PENI	BLOI (N, B	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DR	UNC	FA	PRE	20 40 60 80	MO	LL	PL	PI	PAS	ES INT OT
ľ	4		7	6" Concrete	3.5						-		10	26	15	11	57	
-	$\frac{1}{2}$			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.5		<b>†</b>					φ	10	26	15	11	57	
				hard with calcareous nodules below 2'	4.5								9					
	$\mathbb{N}$																	
_ ا	$ \uparrow  $			with ferrous nodules below 4'	4.5								8					
- <i>5</i> - -		CL			4.5		•					•	10					
-	1				4.5		<b>▲</b> * <b>♦</b>	117	2.25		0	φ	10					
- 10 -				Fat Clay with Sand (CH), hard, high plasticity, light gray and tan with calcareous nodules	4.5		•					<b>-</b>	19	53	19	34	85	
- -		СН		very stiff with ferrous nodules below 12'	4.0		•						19					
Dry	er Oi		ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  SPT    Shelby Tube    Disturbed	Key i N P T Q D	to Abb - SF - Po - To - Un D- Dr	previations: PT Data (Blows/Ft) pocket Penetrometer (tsf) proconfined Comp. Strength (tsf) by Density (pcf)		gered t			Die Grouted after Drilling. D By: Jitu/John, QC/QA By:		By:	Van a	and S	Sons	, Logged

		<b>A</b> = = =		to d Tostino I abountonias Inc			LOG OF	BC	PIN	IG B	-3	<b>PAGE</b> 1 OF 1	DAT	TE			7/	/19/2013
	F	4550	3	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PRO	OJECT	T: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent ir	ı H	-lammerly Area	SUF	RFAC	E ELI	EVAT		2.90
			I	Houston, Texas-77054	PRO	OJECT	TNO.: G13-164		r-3 RING T	YPE:	Αu	uger	(%)		ERBI MITS(		(%)	r 9, 4RKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	OMP.	(%) N		Natural Moisture Content	CONTENT (		7	NDEX	IEVE (	GLE OI TION ( & REM,
ft.)	S	USO	C	Vogue Ln. Northing: 13860651.69	POCKET PENETROMETER(P,tsf	UNT 'oot)	<b>△</b> O (tsf) <b>△</b>	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	RE (psi)	and Atterberg Limits		LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEРТН (ft.)	SAMPLES		ATER	Easting: 3068586	XET	BLOW COUNT (N, Blows/Foot)	★ DD (pcf) ★         90 100 110 120         ◆ P (tsf) ◆	Y DEN	CONFI	ILURE	PRESSURE (	Plastic Moisture Liquid Limit Content Limit	MOISTURE	LIQUID LIMIT	PLAST	PLAST	SSING	STIMAT TERNA THER T
- 0	S		3	MATERIAL DESCRIPTION	POCKE PENETF	BLO (N, E	1.0 2.0 3.0 4.0	DR	UN	47 OO	PR	20 40 60 80	M	LL	PL	PI	PA	G ≷ ES
  -	$\frac{1}{\sqrt{2}}$			6" Concrete  Fat Clay with Sand (CH), soft, very high plasticity, light gray and tan	0.5		•					<b>p</b>	24	68	22	46	71	
-	$\frac{1}{}$			stiff with ferrous nodules below 2'	2.0		•					<b>1</b>	19					
- - 5				very stiff below 4'	3.0		•						17					
- -	1	СН			3.0		•					φ	24					
- - -				stiff below 8'	2.0		<b>*</b>	98	0.6		0	φ	25					
- 10 -	1			very stiff below 10'	3.5		•					<b></b> 1	20	62	21	41	80	
- -					3.0		•						19					
Dry	er O		ations	Intial:   After Drilling  24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:  SPT    Shelby Tube    Disturbed	Key t N P T Q D	to Abb - SP - Po - Toi - Un D- Dr	previations: PT Data (Blows/Ft) cket Penetrometer (tsf) rvane (psf) coonfined Comp. Strength (tsf) y Density (pcf)		gered t			ole Grouted after Drilling. D By: Jitu/John, QC/QA By:		By:	Van a	and S	Sons	, Logged

1101 02										L	OG O	FΒ	OF	RIN	G E	3-3	6	PAGE	1 OF 1	DA	TE			7/	09/2013
	F	Asso	cıai 3	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PR	OJE	CT:	Pro	opos	ed W	/ater Lir	ne Re	epla	acen	nent	in F	lamme	erly Area		SUI	RFAC	E EL	EVAT	ION	4.32
			1	Houston, Texas-77054	PR	OJE	CTI	VV I NO.:			-000035			s NG T\	YPE:	Αι	ıger			(%)	1	ERBI MITS(			
				LOCATION	D, tsf)			• 20			ft) • 80	u u	QVV	J	(%)		Natu	ral Moisture C	Content					EVE (%	iLE OF TON (°, REMA
			VEL	Lexford Ln.	ETER(I	<b>5</b> :	(tc		<b>▲</b> C	u (tsf)	7 80 ▲ 0 4.0			(tsf)	TRAIN	(psi)	,	and Atterberg Limi	its	CONTENT	IMIT	; LIMIT	ITY IN	200 SII	D ANG FRICT STS &
DEРТН (ft.)	SAMPLES	USC	TERLE	Northing: 13860246.38 Easting: 3067458.94	(ET TROM	BLOW COUNT	ows/Fo		★ DI 100	D (pcf) 0 11	→ 0 120	DRY DENSITY (pcf)	ONEW	STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING PRESSURE (	Plastic Limit	Content	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEI	SAI		W	MATERIAL DESCRIPTION	POCKET PENETE	ВГОИ	(N, Bk	<b>♦</b> 1.0		P (tsf) ) 3.0	<b>♦</b> 0 4.0	DRY	JAI	STR	FAIL	CON	⊢ – 20	40 60	– – -I 80	MOIS	ILL	PL	PI	PAS	EST INTL OTH
- 0	$\mathcal{I}$	ۇ د	4	7" Concrete					1 1		: : :														
-	$\frac{1}{\sqrt{1}}$			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	4.0						•						g			14	35	16	19	69	
-	$\frac{1}{}$			with calcareous nodules below 2'	4.0						•									9					
- - 5	<del>-</del>			with ferrous nodules below 4'	3.5						•									11					
- -	4				4.0						•						0			13					
- -	$\frac{1}{\sqrt{1}}$	CL			4.0				•		**	116	8	1.7		0	φ			13					
- 10 -	$\frac{1}{\sqrt{1}}$				3.5						•						Φ			16					
-  -  -	$\frac{1}{2}$				4.0				<u></u>		•	120	0 2	2.08		9	0			15					
- - 15	#				4.0						•						<b>0</b>			16	45	18	27	70	
Dry	er O		ations	Intial:   After Drilling 2 24 Hrs:  Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube Disturbed	N P T G	I - S - F - T Q - U	SPT Pock Forva Jncc	eviation Data ( ket Per ane (p. onfined Density	(Blows netrom sf) d Com	netér (1 p. Stre	tsf) ength (tsf)	A						uted after Dr. d By: Jitu/Jo					son a	and S	Sons ,

		4					LOG OF	BC	RIN	G B	-3	PAGE 1 OF 1	DA7	TE			7/	/22/2013
	Α	1 <i>SSO</i>	cıaı 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PRO	OJEC	CT: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent ir	n H	łammerly Area	SUF	RFAC	E ELL	EVAT		4.50
			I	Houston, Texas-77054	PRO	OJEC	T NO.: G13-164		ring T	YPE:	Au	ıger	(%)		ERBE MITS(			ESTIMATED ANGLE OF INTERNAL FRICTION (%), OTHER TESTS & REMARKS
				LOCATION	P,tsf)		● N (blows/ft) ● 20 40 60 80	(fc	OMP.	(%) ^		Natural Moisture Content			7	VDEX	EVE (	3LE OI TION ( ? REM,
		USO	EVEL	Elmgate Dr.	ETER(	N (fo	<b>▲</b> () (tsf) <b>▲</b>	) YT	ED CC f (tsf)	TRAII	(bsi)	and Atterberg Limits	CONTENT	IMIT	C LIMIT	II YTIC	200 S	D ANC FRIC
DEPTH (ft.)	NT LES	030	TERLI	Northing: 13860361.95 Easting: 3067926.46	POCKET PENETROMETER(P,tsf	BLOW COUNT (N. Blows/Foot)	* DD (pcf) * 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	PRESSURE (	Plastic Moisture Liquid Limit Content Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	IMATE ERNAL IER TE
O DEI	NA.		W	MATERIAL DESCRIPTION	POCK PENE	BLON (N. BK	♠     P (tsf)     ♠       £     1.0     2.0     3.0     4.0	DRY	UNC	FAIL	PRE	+	MOR	IL.	PL	PI	PAS	EST INTE OTF
	1			5" Concrete Fat Clay with Sand (CH), stiff, high plasticity, dark gray	1.5		•					l ip÷÷≕⊣	23	57	20	37	82	
	7				2.0								22					
					0.0		•						000					
- 5 -	$\left  \right $				2.0		•					<b>+</b> • • • • • • • • • • • • • • • • • • •	26					
		СН		very stiff, light gray and tan with ferrous nodules below 6'	2.5		•					<b>P</b>	22	59	20	39		
				with calcareous nodules below 8'	3.0							•	20					
- 10 <del>-</del> 				stiff below 10'	2.0		<b>*</b>	99	0.5		0	•	22					
				Sandy Lean Clay (CL), very stiff, high plasticity, light gray and tan	3.5							<b>+</b> 1	17	43	18	25	70	
- 15	7	CL		with ferrous nodules below 14'	4.0		•					0	16					
Water Water Dry Sample	OŁ	bserva	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube	N P T Q	- SF   - Pc   - Tc   <sub>  </sub> - Ur	breviations: PT Data (Blows/Ft) ocket Penetrometer (tsf) orvane (psf) nconfined Comp. Strength (tsf) ry Density (pcf)		gered t			le Grouted after Drilling. Dr By: Jitu/John, QC/QA By: F		Ву:	Van a	and S	Sons	, Logged

	1	gga	oias	tod Tosting Laboratories Inc			LOG OF	BC	RIN	IG B	-3	38 PAGE	1 OF 1	DA	TE			7/	/19/2013
	A	3300	3	ted Testing Laboratories, Inc. 1143 Yellowstone Blvd	PRO	OJECT	T: Proposed Water Line WBS No. S-000035-	. Rep	olacen )-3	nent i	n F	Hammerly Area		SUI	RFAC	E ELI	EVAT		4.28
			F	Houston, Texas-77054	PRO	OJECT	TNO.: G13-164		RING T	YPE:	Αι	uger	•	(%)		TERBL MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	OMP.	(%) N		Natural Moisture ( and	Content	CONTENT (		7	NDEX	PASSING #200 SIEVE (%)	GLE OI TION ( & REM
(;)		JSC	EVEL	Greyburn Ln. Northing: 13860085.3	METER	JNT oot)		SITY (p	VED C	STRAI	E (psi)	Atterbera Lim			TIMIT	IC LIMI	CITY	#200 S	ED AN L FRIC ESTS .
DEPTH (ft.)	INIT LE		ATER L	Easting: 3068058.86	POCKET PENETROMETER(P,tst	BLOW COUNT (N, Blows/Foot)	* DD (pcf) * 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	PRESSURE (	Plastic Moisture Limit Content ⊢ – – – ← –	Liquid Limit — — -	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SSING	TIMAT. ERNA HER T
	5	r.	Ŋ	MATERIAL DESCRIPTION	POCKE PENETF	BLOV (N, B	6	(BB)	UNC	FA	PRE	20 40 60	80	MO	LL	PL	PI	PAS	ES' INT OT,
	4	7		6" Concrete	4.5									11	36	17	19	68	
				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5		<b>\</b>					φ		''	30	17	19	00	
				with calcareous nodules below 2'	4.5									9					
- 5 -	7	CL		with ferrous nodules below 4'	4.5			117	2.25		0			12					
 					4.5							φ.		15					
				Fat Clay with Sand (CH), very stiff, very high plasticity, light gray and tan	3.5		•					<b></b>		20	67	21	46		
- 10 <del>-</del> 		СН			3.0		•					φ		15					
	7			with ferrous nodules below 12'	4.0		•							13					
Water Water Dry				Intial: ∑ After Drilling▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level:	N P T	- SP - Poi - Toi	breviations: PT Data (Blows/Ft) ocket Penetrometer (tsf) orvane (psf) oconfined Comp. Strength (tsf)		gered t			ole Grouted after Di By: Jitu/John, QC/			Ву:	Van a	and S	Sons	, Logged
Sampl	e K	ev:	$\boxtimes$ s	SPT 🛮 Shelby Tube 🗏 Disturbed	Ď	D- Dry	ry Density (pcf)												

1.0. 02	4		•							L	OG	OF	BC	RIN	IG	B-3	39		PAGE	1 OF 1	DA	TE			7/	19/2013
	A	SSO.	cıai 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	T:	Pro	pos	ed W	Vate	er Line	e Rep	olacei	mer	nt in I	Han	nmer	ly Area		SUI	RFAC	E ELI	EVAT	ION	2.30
			1	Houston, Texas-77054	PR	OJEC <sup>*</sup>						0035-		r-3 RING 1	TYPE	: A	uge	r			(%)		ERBI MITS(			
				LOCATION	P.tsf)			• 20	N (b	olows/	(ft) O		(f)	MP.	(%)			Natura	al Moisture (	Content					PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
			VEL	Parana Dr.	ETER(		3	<b>A</b>	Q	) <sub>u</sub> (tsf) ) 3.0	_		) YT	ED CC (tst)	TRAIN	i (nei)	(100)	Ai	and tterberg Lim	its	CONTENT	TIMIT	רואוד:	NI XII	200 SI,	D ANG FRICT STS &
DEPTH (#.)	SAIMPLES	USC	YER LE	Northing: 13860083.04 Easting: 3068506.72	ET TROM	BLOW COUNT (N. Blows/Foot)		90	. DE	) (pcf,	) <b>*</b>		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	CONFINING	PI	astic imit	Moisture Content	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING#	IMATE ERNAL IER TE
DEF	NAN NAN		W	MATERIAL DESCRIPTION	<i>POCKET</i> PENETR	BLOW (N. BK	; ;	<b>♦</b> 1.0	P	(tsf) 3.0		<b>♦</b>	DRY	UNC	FAIL	CON	1	⊢ – - 20	 40 60	—I 80	MOIS	LL		PI	PAS	EST INTE OTH
	I	4	4	6" Concrete			1	:	: :	: :	:	: :						: :	1 1 1	1 1 1						
				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5							•					G	)			9					
					4.5							•					$\phi$	<b>+</b> -	4		6	37	17	20	60	
 - 5 -	}	CL		with sand seam below 4'	4.5													)			10					
				with ferrous nodules below 6'	4.5							•	-					)			9					
				Fat Clay with Sand (CH), hard, high plasticity, light gray and tan	4.5													<b>φ -</b> -			15	65	21	44	85	
- 10 -				with ferrous nodules below 10'	4.5								109	2.25		0					16					
		CH							<b></b>	* *																
   					4.5							•									13					
IA/ata:		<i>(a)</i>		lotiols T. After Drilling	Vari	to Ab-	bro: #=	ntio ==	<u> </u>				Mate													
Dry	Ob.	serva	tions	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:	Key N F T C	to Abb I - SF - Po - To I - Ur ID- Dr	previa PT Da ocket orvand nconfi	ations ata (E Pene e (ps ined	s: Blows, etrom f) Com,	/Ft) eter (i	ítsf) ength	n (tsf)		gered					ed after Di John, QC/			Ву:	Van a	and S	Sons	, Logged
Sampl	le K	ey:	$\boxtimes$ $\mathfrak{S}$	SPT $oxine$ Shelby Tube $oxine$ Disturbed	D	D-Dr	ry Dei	nsity	(pcf)		-	. ,														

	4	. ,						L	LO	G OF	BC	RIN	IG I	B-4	0	PAGE	1 OF 1	DAT	Έ			7/	10/2013
	Assoc	cıat 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PF	ROJECT	: P	ropo	osed	Wat	ter Lin	e Rep	olacen	nent	in H	amme	rly Area		SUF	RFAC	E ELI	EVAT		3. <i>78</i>
		I	Iouston, Texas-77054	PF	ROJECT					<i>)</i> 0035-		ring T	YPE:	Au	ger			(%)		ERBE //ITS(			
			LOCATION	D tef	(161, 17)	2		l (blow 40		<b>•</b> 80	(Jc	OMP.	(%) N		Natur	al Moisture	Content	• .				PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		EVEL	Springwood Forest Dr.	=TER	£ 45	1	<b>A</b>	Q <sub>u</sub> (ts 2.0	sf)	<b>A</b>	γ. (p	ED CC (tst)	TRAII	; (psi)	A	and Atterberg Lin	nits	CONTENT	IMIT	: FIMI.	// YTI:	200 S	D ANG FRIC
DEPTH (ft.)	USC	TER LE	Northing: 13859791.16 Easting: 3064335.42	ET	BLOW COUNT (N, Blows/Foot)	٤	*	DD (p 100	cf)	*	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #.	ESTIMATE INTERNAL OTHER TE
DEF	5	WA	MATERIAL DESCRIPTION	POCKI	BLOW N, Blo	1	<b>•</b>	P (ts: 2.0	sf)	<b>4</b> .0	DRY	UNC	FAIL	CONI PRES	<b>⊢</b> − 20		-	MOIS	IL	PL	PI	PASS	ESTI INTE OTH
- <i>0</i> 1	/	4	5.5" Concrete			:		: :	1 1														
			Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5						•					P			15					
				4.5						•								11					
 - 5 -			with ferrous nodules below 4'	4.5						•	 				<b>+-</b>	+		10	35	16	19	51	
	CL		very stiff below 6'	4.0						•					•			13					
				4.0						• • • • • • • • • • • • • • • • • • • •	-				•			12					
- 10 <del>-</del> 				3.5					*	•	113	1.15		0	•			10					
				2.5											<b>d</b>	H		13	33	16	17		
Dry		tions.	ntial: \(\times\) After Drilling\(\times\) 24 Hrs: \(\times\) Initial Water Level: Dry, After Drilling Water Level:  PT \(\begin{align*} \text{Shelby Tube}  \begin{align*} \text{Disturbed} \end{align*}		to Abb. N - SP P - Poo T - Toi Q <sub>u</sub> - Uni DD - Dry	T Data cket P vane confin	a (Blor lenetro (psf) ed Co	mp. S	r (tsf) Streng	nth (tsf)		gered t				ted after D By: Jitu/J					son a	and S	Sons ,

		888	ai ai	ad Tagting Laboratories Inc						L	-00	G OF	BO	DRIN	١G	B-	<b>4</b> 1		PAGE	1 OF 1	DA	TE			7,	/10/2013
	A	.550	с <i>і</i> аі 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	Pl	ROJE	CT:	P	ropo	sed No.	Wat	ter Lin 00035	e Re	olacei	mei	nt in	Ha	ammerly	Area		SUI	RFAC	E ELI	EVAT		6.87
			F	Houston, Texas-77054	PI	ROJE	CT I		G1			70033		r-3 RING T	TYPL	E: A	Aug	ger			(%)		ERBI MITS(		(%)	F °), ARKS
	T			LOCATION		BLOW COUNT				10	60	80	(pcf)	OMP.	(%) N	(o/ ) •		Natural N	loisture ( and	Content	CONTENT		7	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		USC	EVEL	Springwood Forest Dr.	į į	INT NA	oct)	1.	.0 2	$Q_u$ (ts	3.0	4.0	ק) אדונ	JED C	STRAI	5 0	E (psi)		berg Lim			LIMIT	C LIMI	CITY I	#200 S	ED ANGL. FRICTIC
DEPTH (#.)	SAMPLES	000	TERL	Northing: 13859804.64 Easting: 3065118.21	(ET	700 /	ows/Fc		0 1	DD (pi 00 - 1	110		DRY DENSITY	UNCONFINED COMP. STRENGTH (tsf)	FAILUBESTRAIN	CONFINING	SSUR	Plastic N Limit (	Moisture Content	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	LASTI	SING #	ESTIMATE INTERNAL OTHER TE
o DE	NA.		WA	MATERIAL DESCRIPTION	POCKI	BLOV	(N, B)	1.		P (tsi 2.0 :		<b>♦</b> 4.0	DRY	UNC	FAII	VO3	PRE	20 4	0 60	1 80	MOK	LL	PL		PAS	ES7 INT <sub>1</sub>
	A	2		5.5" Concrete	4.5																11					<u> </u>
-				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.0		,					•						φ								
- 				very stiff with sand seam below 2'	3.0	,					•							<b>H1</b>			13	35	16	19	51	
 - 5 -					3.5	;					•							•			14					
		CL		stiff with ferrous nodules below 6'	2.0	,		•		•		<b>F</b>	116	0.85		C	,   .	φ			14					
					2.0	,				•								Φ			15					
- 10 - 				very stiff below 10'	2.7:	5				•								Φ			14					
 					3.5	;					•	•						<b>D1</b>			15	35	16	19	69	
Dry	Ob.	serva	tions.	ntial:   After Drilling 2 24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:		P - F T - T Q U	SPT Pock Torv Unce	Data et Pe ane ( onfine	(Blow enetro psf) ed Cor	metér mp. S	r (tsf)	ıth (tsf)		gered				Grouted ecked By						son a	and S	Sons ,
Samp	le K	ίeν:	Ms	SPT 🛮 Shelby Tube 🗏 Disturbed		DĎ - Ì	Dry I	Densi	ity (pc	:f)	9	( /														

	4		oi at	tod Tosting Laboratories Inc						L	-00	G O	FI	BC	RIN	IG I	B-4	2			PAG	iE 1	OF 1	DA	TE			7/	/10/2013
	А	ISSO	cıaı 3	ted Testing Laboratories, Inc. 8143 Yellowstone Blvd	Pl	ROJEC	T:	Pro	pos	sed	Wai	ter Li 0003:	ine i	Rep	lacen	nent	in F	lan	nme	rly A	Area			SU	RFAC	E EL	EVAT		7.71
			I	Houston, Texas-77054	Pl	ROJEC	T NC					0003			-3 RING T	YPE:	Αι	ıge	r					(%)		ERBI MITS(			
				LOCATION		PENETHOMETER(P, 187) BLOW COUNT (N. Blows/Foot)		• 20		0 (	60	80		(bct)	OMP.	(%) N		1	Vatur		oisture and	e Con	ntent	CONTENT		7	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		USC	EVEL	Hollow Hook Rd. Northing: 13859598.69	į	INT Soft		1.0	2.	Q <sub>u</sub> (ts 0 : 3	3.0	4.0		ק) אדונ	VED C H (tsf)	STRAI	G E (psi)			Atterb	erg Li				LIMIT	C LIMI	CITY I	#200 S	ED ANGL
DEPTH (#.)	SAMPLES	000	TERL	Easting: 3065233.6	(E7	V COL		90	<b>★</b> D	00 1	110	<b>★</b> 120		DRY DENSITY	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Pla Li	astic imit	$C_0$	oisture onteni >	t	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	LASTI	SING ;	ESTIMATI INTERNA OTHER TI
o DE	SA		WA	MATERIAL DESCRIPTION	POCKI	PENE BLOV		<b>♦</b> 1.0		P (tst 0 - 3		<b>♦</b> 4.0		DRY	UNC	FAI	CON		20	40	_		<b>-1</b> 80	MOK	LL	PL		PAS	EST INT.
	Д	1	4	7" Concrete				:										:	:			:							
				Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5		:					•	· · · · ·					;	φ					17					
					4.5							•	•						<b>\rightarrow</b>					17					
				with ferrous nodules below 4'	4.5	,																		16	33	17	16	55	
- 5 -								:				•							<del>-</del>	<del>-1 -</del>				_					
		CL			4.5			:																17					
					4.5									114	2.15		0	3						17					
					7.0					<b>A</b>	*		•		2.70				<b>d</b>										
- 10 -				very stiff below 10'	3.5	;		<u>:</u>																17					
   											•	· · · · · · · · · · · · · · · · · · ·							0										
	И				4.0							•							₫⊣					16	27	15	12	51	
Water Water Dry				Intial: ☑ After Drilling.▼ 24 Hrs: ▼ : Initial Water Level: Dry, After Drilling Water Level:		to Abl N - SF P - Po T - To Q <sub>u</sub> - Ur	PT Da ocket orvan	ata (l Pende (ps	Blows etron sf)	netér	r (tsf)				s: gered t ged B												son a	and S	Sons ,
Samp	le k	(ev:	$\boxtimes s$	SPT  Shelby Tube  Disturbed		Q <sub>u</sub> - Ur DD- Dr	ıconi y De	ined ensity	com (pcf)	ιμ. 31 )	ueng	μιτ (IST <i>)</i>	'																

	4		ai a	ted Testing Laboratories Inc			LOG OF	BC	RIN	IG E	3-4	-3	PAGE	1 OF 1	DA	TE			7/	09/2013
	A	ISSO		ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PRO	OJECT	T: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent	in F	lammer	ly Area		SUI	RFAC	E EL	EVAT		7.38
			1	Houston, Texas-77054	PRO	OJEC 1	TNO.: G13-164		RING T	YPE:	Αι	ıger			(%)		ERBI MITS(		(%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	OMP.	(%) N		Natura	al Moisture C and	Content	CONTENT		7	PLASTICITY INDEX	PASSING #200 SIEVE (%)	GLE O. TION ( \$. REM.
_		USO	EVEL	Springwood Forest Dr.	ETER	NT ot)		g) YTI	ED Co	TRAI	ع : (psi)	A	anu tterberg Lim	its		TIMIT	CLIMI	I YTIC	200 S	D AN
DEPTH (ft.)	SAMPLES	USC	TERLI	Northing: 13859809.36 Easting: 3065716.21	POCKET PENETROMETER(P,tsf	COU	★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	ASTIC	SING#	IMATE ERNAL ER TE
O DEF	SAN		WA	MATERIAL DESCRIPTION	<i>POCKE</i> 1 PENETF	BLOW COUNT (N, Blows/Foot)	♦ P (tsf) ♦ 1.0 2.0 3.0 4.0	DRY	UNC	FAIL	CON	+ − - 20	 40 60	— <b>-</b> 1 80	MOIS	IL.	PL	PI	PAS	EST INTE OTH
[ " ]	И			6" Concrete											10					
-	$\left\  \cdot \right\ $			Sandy Lean Clay (CL), hard, medium plasticity, lght gray and tan	4.5		•					φ			12					
-					4.5										10	35	16	19	61	
-	$\parallel$						•					0	<b>-</b>							
- 5 -				very stiff with calcareous nodules below 4'	4.5			123	1.95		0				11					
	Ц			· · · · · · · · · · · · · · · · · · ·																
		CL		with ferrous nodules below 6'	4.0		•							:	12					
-	Ц				3.5										13					
-	$\left\  \cdot \right\ $				0.0		•					φ								
- 10 -	Н			stiff below 10'	2.0			108	0.85		8				17					
-	$\left\  \cdot \right\ $						<b>★ ♦ ★</b>					$\phi$								
	1				2.0										18	39	17	22	70	
-	Н	Ź																		
Water				Intial:   After Drilling  24 Hrs:  Intial:   After Drilling  After Drilling  After Drilling	Key t	to Abb - SP	breviations: PT Data (Blows/Ft)	Note		to 12'	Нα	le Grout	ed after Dr	illing Dr	rilled	By	lohn	con :	and s	Sone
Dry	UĽ	serva	auons	: Initial Water Level: Dry, After Drilling Water Level:	P T	- Poi	ocket Penetrometer (tsf)						eu aner Dr By: Jitu/Jo					3011 č	anu č	JUIS ,
Samp	le k	(ev:	$\boxtimes$ s	SPT 🛮 Shelby Tube 🗏 Disturbed	Q D	u - Un D- Dry	nconfined Comp. Strength (tsf) ry Density (pcf)													

		4	•	4-1T-4: I -l4:- I				L	OG (	OF I	BO	RIN	IG I	B-4	4		PAGE	1 OF 1	DA	TE			6/	20/2013
	P.	ASSC	ocia	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJEC	T: Pro	posed	Water L S-00003	Line I	Rep	lacen	nent	in F	lamm	erly	Area		SUI	RFAC	E ELI	EVAT		5.45
			j	Houston, Texas-77054	PRO	OJEC :		G13-16				-3 RING T	YPE:	Αι	ıger				(%)		ERBE MITS(			ESTIMATED ANGLE OF INTERNAL FRICTION (%), OTHER TESTS & REMARKS
				LOCATION	P,tsf)		20		vs/ft) ● 60 80		c):	JMP.	(%)		Nat	ural N	Noisture C	Content					PASSING #200 SIEVE (%)	ale of Tion (°
		ш	-VEI	Rosefield Rd.	ЕТЕВ(	N7 ot)		▲ <i>Q</i> ,, (ts	sf) ▲ 3.0 4.0	,	77 (pc	ED CC I (tsf)	TRAIN	; (psi)		Atte	and rberg Lim	its	CONTENT	TIMIT	CLIMIT	AI YTIC	200 SI	D ANC FRICT
DEРТН (ft.)	SAMPLES	US	C HER LI	Northing: 13859788.12 Easting: 3066220.72	POCKET PENETROMETER(P,tsf	BLOW COUNT (N, Blows/Foot)	90	★ DD (p	cf) * 110 120	,	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plasti Limit	ic I t	Moisture Content	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING#	IMATE ERNAL IER TE
o DEF	SAN		W	MATERIAL DESCRIPTION	POCK PENE	BLON (N, Bk	1.0	P (ts	f) ◆ 3.0 4.0		DRY	UNC	FAIL	CON	+ - 20	0 4	- → - 40 60	— — - <b>I</b> 80	MOIS	IL.	PL	PI	PAS	EST INTE OTH
ľ	И		A 4	5.5" Concrete	]		1 : :	: : :		:					: :	:								
-	$\frac{1}{2}$			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.5				•						9-				14	35	16	19	70	
_	$\dagger$			soft with sand seam below 2'	0.5														18					
-		CL		very stiff with ferrous nodules below 4'	3.5		•								Ò				17					
- 5									•															
-					3.0				•						9	\			18					
- -	+			Fat Clay with Sand (CH), stiff, very high plasticity, light gray and tan with ferrous nodules	1.5			<b>.</b>								<b>├</b>		-	35	77	23	54		
- 10	1	СН			2.0						104	0.85		0		$\int$			25					
-    -	$\frac{1}{4}$				_		<b>A</b>	****								Φ								
Dry	er Ol	bserv	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:	N P T Q	- SF - Po - To: - Un	cket Pen rvane (ps nconfined	Blows/Ft) etromete sf) ' Comp. S				ered t						rilling. Di hn, QC/				son a	and S	Sons ,
Sam	ple l	Kev:	X.	SPT $\square$ Shelby Tube $\square$ Disturbed	D	Ď- Dr	y Density	(pcf)	5 (	´														

	ACE EL	ELEVA	/ATIO	24/
Colorete   Sandy Lean Clay (CL), hard, medium   Attorior of the color of the colo	TTERB			83.86
Concrete   Sandy Lean Clay (CL), hard, medium   Location   Locat	LIMITS		.	PASSING #200 SIEVE (%) ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
Sandy Lean Clay (CL), hard, medium 4.5	7	, NDEX	VDEX	PASSING #200 SIEVE (%) ESTIMATED ANGLE OF INTERNAL FRICTION (?), OTHER TESTS & REMAR
Sandy Lean Clay (CL), hard, medium 4.5	CLIMIT			ED AN
Sandy Lean Clay (CL), hard, medium 4.5	PLASTIC LIMIT	PLASTIC LIMIT	LASTI	SING #
6" Concrete   Sandy Lean Clay (CL), hard, medium 4.5   11		- 1	5) p	FAS EST INT, OTF
Sandy Lean Clay (CL), hard, medium				
with calcareous nodules below 2'  4.5	32 16	6 16	16 6	58
with ferrous nodules below 4'  4.5				
4.5 A D D D D D D D D D D D D D D D D D D				
4.5	19 19	9 30	80 5	56
- 10				
very stiff below 12' 3.5				
Water Level Intial: ☑ After Drilling ▼ 24 Hrs: ▼ Key to Abbreviations: Notes:  Water Observations: Initial Water Level: Dry, After Drilling Water Level:  N - SPT Data (Blows/Ft) P - Pocket Penetrometer (tsf) T - Torvane (psf) Q, Unconfined Comp. Strength (tsf) DD- Dry Density (pcf)  Notes: Augered to 13', Hole Grouted after Drilling. Drilled By BY: PV, Checked By: Jitu/John, QC/QA By: PST	/: Van	n and	d So	ons , Logged

		A aaa	aia	ted Testing Laboratories Inc			LOG OF	BC	PIN	IG B	-4	6	PAGE 1 C	OF 1	DAT	Έ			7/	09/2013
	F	4550	3	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PR	OJEC	CT: Proposed Water Line WBS No. S-000035-	e Rej	olacen	nent ii	n H	lammerly A	rea		SUF	RFAC	E ELI	EVAT		3.67
			1	Houston, Texas-77054	PR	OJEC	CT NO.: G13-164		RING T	YPE:	Au	ıger			(%)		ERBE MITS(		(%	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● N (blows/ft) ● 20 40 60 80	ct)	OMP.	(%) N		Natural Moi	sture Conte	ent	CONTENT (		7	NDEX	IEVE ('	GLE OI TION ( & REM.
t.)	(0)	US	EVEL	Lexford Ln. Northing: 13859841.1		JNT	▲ O (tef) ▲	g) YTI8	VED C. H (tsf)	STRAI	Ĕ (psi)	Atterbe	erg Limits			LIMIT	C LIMI	CITY	#200 S	ED AN L FRIC ESTS a
DEРТН (ft.)	SAMPLES		ATER L	Easting: 3067107.58	POCKET PENETROMETER(P,tst	BLOW COUNT (N. Blows/Foot)	★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	PRESSURE (	Limit Co	isture Li ntent L ← – – –	iquid Limit 	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	TIMAT. TERNA HER T
- 0E	SA		Ž	MATERIAL DESCRIPTION	POCKE. PENETF	BLO1	♠     P (tsf)     ♠       £     1.0     2.0     3.0     4.0	DR)	UNC	FA	PRE	20 40		·	MO	LL	PL	PI	PAS	ES INT
[ "	$\mathbb{N}$		A 4	9" Concrete										:						
-	1			2.5" Crushed limestone Fat Clay with Sand (CH), very stiff, high	2.5		•					φ			17					
_	$\dagger$			plasticity, light gray and tan with ferrous nodules below 2'	4.0										15					
-	$\parallel$						•					0								
<u>ا</u> ا	$\prod$			firm with sand seam below 4'	1.0									:	21	56	20	36	<i>75</i>	
- 5	$\mathbb{I}$													:						
_	$\prod$			very stiff with calcareous nodules below 6'	3.0		•								29					
-	$\mathcal{H}$	СН		with slickensided layer from 8' to 10'	3.5			109	1.35		0				20					
-	-											$\phi$								
- 10	$\dagger$				3.0										16					
_	$\parallel$											ф								
_	$\forall$				4.0										19					
	$\mathbb{I}$											0								
- 15					4.0		•					<b>b</b>			21	66	21	45	85	
Dry	er O		ations	Intial: ♀ After Drilling▼ 24 Hrs: ▼ :: Initial Water Level: Dry, After Drilling Water Level:  SPT □ Shelby Tube □ Disturbed	N P T G	- SF   - Pc   - To   - Ur	breviations: PT Data (Blows/Ft) ocket Penetrometer (tsf) orvane (psf) nconfined Comp. Strength (tsf) ry Density (pcf)		gered t			le Grouted at hecked By: J						son a	and S	Sons ,

				OD. GD 1 3/0/10					L	OG OI	BO	DRIN	IG	<b>B-4</b>	<b>.</b> 7		PAGE	1 OF 1	DA	TE			7/	19/2013
	A	lsso	ciai	ted Testing Laboratories, Inc. B143 Yellowstone Blvd	PR	OJEC	CT:	Propo	sed V	Vater Lin	e Re	olacer	men	t in F	lami	merl	y Area		SUI	RFAC	E ELL	EVAT	ION	
				Houston, Texas-77054				WBS	No. S	5-000035	-0180	)-3								ATT	ERBE	RG	84	4.60 g
				,				vo.: G1			ВО	RING T	YPE	: Αι	ıger				(%)		ИITS(	%)	(%)	)F (°), 1ARK
				LOCATION	(P.tsf.					/ft) ● 60 80	ct)	JMP.	(%) N		N	atural	Moisture C	Content	CONTENT		7	NDEX	IEVE	GLE ( TION & REA
			VEL	Elmgate Dr.	ETER				Q <sub>u</sub> (tsf	) <b>▲</b> .0 4.0	ر م) 77	ED C	TRAI	i (psi)		Att	and terberg Lim	its	CON	IMIT	; FIMI	1 771	500 S	D ANI FRIC STS a
DEPTH (ft.)	SAMPLES	USC	ERLE	Northing: 13859945.06 Easting: 3067568.62	:T ROMI	con	)   N	* 1	DD (pc	f) <del>*</del> 10 120	ENSI	NFIN	FAILURE STRAIN (%)	INING	Plas Lin	stic nit	Moisture Content	Liquid Limit	TURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	ING #.	WATE RNAL ER TE
DEP.	SAM		WAT	MATERIAL DESCRIPTION	<i>POCKET</i> PENETE	BLOW COUNT	, <u>D</u>	<b>♦</b>	P (tsf)	•	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILL	CONFINING PRESSURE	+				MOISTURE	977 LL		PI	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
- 0 >	Н	1	4	5.5" Concrete	<u> </u>	B	-	1.0 2	<u>2.0 3</u>	.0 4.0	+	3		-	:	20	40 60	80		LL	FL	гі		
-	1			Sandy Lean Clay (CL), hard, high plasticity, dark gray	4.5					•					9				12					
					4.5					•						<b>+</b> +			13	45	18	27	69	
 - 5 -	1			light gray and tan with calcareous nodules below 4'	4.5					•						)			15					
- 	1			with ferrous nodules below 6'	4.5					•						<b>P</b>			16					
  - 	1	CL		very stiff below 8'	3.0					• • • • • • • • • • • • • • • • • • • •						<b>\</b>			26					
- 10 - 	1				4.0				\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	* •	114	1.85		0		<i>/</i>			15					
 					3.5					•						<b>,</b>	<b>—</b>		15	39	17	22		
 - 15 -	1				4.0														13					
Water Water Dry Samp	r Ob	bserva	ations	Intial:   After Drilling 2 24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube	F T	l - S. - P. - T. D U	PT L ocke orva Incol	viations: Data (Blov et Penetro ane (psf) onfined Co Density (po	metér mp. Sti	(tsf) rength (tsf)		gered					ed after Dr Iohn, QC/0			Ву:	Van a	and S	Sons	, Logged

## Houston, Texas-77054  ### Houston, Texas-77054    Comparison of the properties o	86.73 \$
HOUSION, Texas-77034  PROJECT NO.: G13-164  BORING TYPE: Auger  LOCATION  Moorberry Ln. Northing: 13859536.04 Easting: 3065842.58  MATERIAL DESCRIPTION  PROJECT NO.: G13-164  BORING TYPE: Auger  Natural Moisture Content and Atterberg Limits  Plastic Moisture Liquid Limit Content Limit +	TED ANGLE OF AL FRICTION (°), TESTS & REMARKS
CONTION   CONTINUES   CONTIN	TED ANGLE OI AL FRICTION ( TESTS & REM
	TED ANG AL FRIC TESTS &
	7 4 7
	IMA ERN, IER
	EST INTE OTH
Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	
2.5	)
with ferrous nodules below 4'  4.0	
with calcareous nodules below 6'  2.5	
Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan with calcareous nodules	
2.25stiff below 10'stiff below 10'	
Water Level Intial:    ✓ After Drilling 2 24 Hrs:  ✓ Key to Abbreviations: Notes:	A Sono
Water Observations: Initial Water Level: Dry, After Drilling Water Level:  N - SPT Data (Blows/Ft) P - Pocket Penetrometer (tsf) T - Torvane (psf) Q - Unconfined Comp. Strength (tsf) DD- Dry Density (pcf)  Augered to 12', Hole Grouted after Drilling. Drilled By: Johnson and Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST  Logged BY: PV, Checked By: Jitu/John, QC/QA By: PST  DD- Dry Density (pcf)	SUIIS,

		4							LC	OG O	F BC	DRIN	<b>IG</b>	B-4	9	PAGE	1 OF 1	DA	TE			7/	11/2013
	A	<i><b>Asso</b></i>	cıai 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PRC	OJEC'	T: P	ropos	ed W	ater Lir	ne Rej	olacer	ment	in F	lamm	erly Area		SUF	RFAC	E ELL	EVAT	ION	3.56
				Houston, Texas-77054	PRO	DJEC'	VV T NO.:			000035		1-3 RING T	YPE:	Αι	ıaer			_		ERBE			
				LOCATION				N (k		t) •	T	Ι.	Ι ¬			ıral Moisture (	Content	NT (%)	LIN	MITS(	-	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
			11	Hammerly Blvd.	ER(P,		2		0 60 0 <sub>u</sub> (tsf)	<i>80</i> ▲	(pct)	cOM st)	SAIN (	(isi		and		CONTENT	11T	TIMI	Y IND	o SIE\	4NGL SICTIC S & F
1 (ft.)	ES	USC	S LEV	Northing: 13859562.09	POCKET PENETROMETER(P,tsf	BLOW COUNT (N. Blows/Foot)	1.	0 2.0	) 3.0 D (pcf)	4.0	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	IING JRE (F	Pļasti	Atterberg Lim  Moisture	Liquid Limit		רומחום רואוב	PLASTIC LIMIT	PLASTICITY INDEX	G #20	ATED , VAL FI TEST
DEРТН (#.)	SAMPLES		VATE	Easting: 3068041.59	POCKET PENETR	JW C Blows	9	0 10		) 120 •	 3Y DE	VCON	AILUF	CONFINING PRESSURE (	Limit ⊢ –	<i>Content</i> 		MOISTURE	רומח		- 1	4SSIN	STIM/ JTERN THER
- 0	S	r.		MATERIAL DESCRIPTION	PO PE	BLC N.	1.		<u>3.0</u>	4.0	Ď	U S	F	D A	20	40 60	80	ğ	LL	PL	PI	Ρ/	ш ≤ О
	1	ì		6" Concrete Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	2.75				•						<b>O</b>	<b></b>		17	35	16	19	70	
	7			plasticity, light gray and tair	2.5													18					
	$\frac{1}{4}$			with farman padulas halaw 41	<i>3.75</i>				•									16					
- 5	$\left\  \cdot \right\ $			with ferrous nodules below 4'	3.75					•								16					
					3.5					•								14					
- ·	1	CL			<i>3.75</i>					•					•			17	43	18	25	70	
- 10 ·	$\frac{1}{2}$				2.5				•						•			19					
- ·	1				3.5					<b>.</b>	114	1		0				17					
- 15 ·	1				4.0					•					<b>0</b>			16	44	18	26		
  -    -	7				4.0					•					0			15					
Wate Wate Dry Sami	r Ol	bserva	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  BPT Shelby Tube	N P T Q	SF - Po - To - Un -	breviation PT Data pocket Pe prvane (p proonfine ry Densi	(Blows enetrom psf) ed Com	netér (ts p. Strei	sf) ngth (tsf)		gered				uted after D d By: Jitu/Jo					son a	and S	Sons ,

	<u> </u>	<u> </u>	•						LC	G	OF E	BOF	RIN	IG E	3-5	0 (I	PZ-2	2)	PAGE	1 OF 1	DA	TE			6/	18/2013
	F	4 <i>SSO</i>	ociai E	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJEC	:T:	Prop	DOSE	ed W	ater L 00003	Line I	Rep	lacen	nen	t in F	lamn	nerly .	Area		SUI	RFAC	E ELL	EVAT		3.40
			1	Houston, Texas-77054	PRO	OJEC	T NO.							-3 RING T	YPE:	: Αι	ıger				(%)		ERBE			ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)			• 20	N (bl 40		(t) • 80		ct)	OMP.	(%) N		Na	tural M	loisture C	Content	CONTENT (		7	NDEX	IEVE (9	GLE OF TION ( & REM/
t.)	(0)	US	EVEL	Truscon Dr. Northing: 13859706.7	<i>IETER</i>	JNT (toc		<b>1.0</b>	Q <sub>u</sub> 2.0	, (tsf) 3.0	4.0		д) ХТІ	VED CO H (tsf)	STRAII	G E (psi)			and berg Lim			LIMIT	C LIMI	CITY I	#200 S	ED ANI L FRIC ESTS A
DEРТН (ft.)	SAMPLES		ATER L	Easting: 3068414.91	KET ETROM	BLOW COUNT		90	100	(pcf)	* 0 120		DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE	Plasi Lim	it C	loisture Content 	Liquid Limit — — -I	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	TIMAT. TERNA. HER T.
OE OE	SA		×	MATERIAL DESCRIPTION	POCKET PENETE	BLO1	2	<b>♦</b> 1.0		(tsf) 3.0	<b>◆</b> 4.0		DR	UNC	FA.	COI	2	20 4	_	80	MO	LL	PL	PI	PAS	ES INT OT
	A			6" Concrete			1	: :		: :		:					:		: :		40	00	47	40	20	
-	$\frac{1}{2}$			Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan ( Fill 4 feet )	4.5							•					φ۲	1			10	36	17	19	69	
-  -	$\frac{1}{}$	CL		with calcareous nodules below 2'	4.5							<b>•</b>									9					
- - 5	1			Sandy Lean Clay (CL), hard, high plasticity, light gray and tan	4.5							•									11	40	17	23		
-	1			with ferrous nodules below 6'	4.5							•					0				13					
- -	4			very stiff with calcareous nodules below 8'	4.0				<b>A</b>	*	•		109	1.75		0	φ				13					
- 10 -	4	CL		hard below 10'	4.5							•					-  -  -		1		11	42	18	24	68	
- -	1				4.5							•									10					
- - 15	1				4.5							•	127	5.19		10					10					
  -  -	1				4.5							•					$\int_{0}^{\varphi}$				17					
Dry, Leve	er O 24 l d: 16	bserva hrs Wa	ations ater L	Intial:   After Drilling 2 24 Hrs:  Initial Water Level: Dry, After Drilling Water Level: evel: Dry, 7 days Water Level: 16', 30 days Water  SPT Shelby Tube Disturbed	N P T Q	- SI - Po - To - Ur	brevia PT Da ocket I orvane nconfii ry Der	ta (Bi Pene e (psf ned (	llows/letrome trome () Comp	eter (t	sf) ength (ts		PΖ	gered t	leve	l: 16'	(7/30	/2013	) Drilled							(6/25/2013); PV, Checked

		~~~		ad Tagtina I abountaries Inc					LC	G O	F BC	RIN	IG I	B-5	1	PAGE	1 OF 1	DAT	ΓE			6/	/20/2013
	$A_i$	ssoc	<i>1a</i> 1 <i>e</i>	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PROJ	JECT:	Pri	opose	ed W	ater Lir 000035	ne Rej	olacen	nent	in H	lammeri	ly Area		SUF	RFACI	E ELE	EVAT		7.99
			H	Iouston, Texas-77054	PROJ	JECT		G13		<i>J</i> 00035		r-3 RING T	YPE:	Au	ger			(%)		ERBE			
			$\prod$	LOCATION	(P,tsf)		<b>2</b> 0	N (b.			(pcf)	ЭМР.	(%) N		Natura	l Moisture (	Content	CONTENT (		7	NDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
		USC		Moorberry Ln.	ETER INT	ot)	1.0	0 2.0	, (tsf) 3.0	4.0	ן מ) אדוו	IED Co	STRAII	G E (psi)		terberg Lin			LIMIT	C LIMI	II XLIO	£200 S	ED ANGL. FRICTIC
DEPTH (ft.)	MPLES	700		Northing: 13859255.63 Easting: 3064334.54	POCKET PENETROMETER(P,tst RLOW, COLINT	(N, Blows/Foot)	90	★ DD 0 100	) (pcf) ) 110	<b>★</b> 120	DRY DENSITY	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Liquid Limit . — — -	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	SING #	ESTIMATE INTERNAL OTHER TE
O DE	Ř	F	WA	MATERIAL DESCRIPTION	POCK! PENE	(N, B)	<b>♦</b> 1.0		o (tsf) 1 3.0	<b>♦</b> 4.0	DRY	UNC	FAII	CON	20	40 60	-	MOK	LL		PI	PAS	ES7 INT.
	A	CL S	×XXX	7" Concrete Sandy Lean Clay (CL), stiff, slight	2.0													16					
	Н			plasticity, light gray and tan (FILL 6 feet )firm below 2'	1.0													16	25	15	10	63	
	$\  \ $ ,	CL 🎇				.									<b>•</b> 4								
	Н				1.0													19					
- 5 -	$\parallel$		$\frac{3}{3}$				•																
				Sandy Lean Clay (CL), very stiff, slight plasticity, light gray and tan with sand	3.5													14					
	Ц			seam											Ĭ								
					3.5					<b>.</b>					\ \ \			17					
- 10 -	Н			firm below 10'	1.25	-					115	0.4		0				15					
	$/\!\!/$					.	•	•		*					ф								
	// (	CL		stiff below 12'	1.5			•							⊕1			17	24	15	9	62	
	Η																						
- 15 -																							
	Ц																						
				hard below 16'	4.5										J	4		13	37	17	20		
	Н		4																				
Water				ntial:   After Drilling   24 Hrs:   After Drilling   Aft	Key to			ns: (Blows/	/Ft)		Note		to 19		lo Groute	ed after D	rilling Du	rillad	By:	lohni	con (	and S	Sono
Dry Dry	Obs	ervau	ons:	Initial Water Level: Dry, After Drilling Water Level:	P .	- Pock	ket Per	netrome	eter (ts	sf) ngth (tsf)	'					By: Jitu/Jo					on a	liiu c	ouis ,
Sampl	le K	ev:	$\mathbb{X}s$	PT Shelby Tube Disturbed	DD.	- Unc	ontined Densit	d Comp ty (pcf)	o. Strei	igtn (tst)													

	4 ~			ad Tastina I about oning Inc					LC	OG O	F BC	DRIN	IG I	B-5	2	PAGE	1 OF 1	DA	TE			6/	20/2013
	AS	socu	ие 31	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PRO	DJECT	: Pr	ropos	sed W	ater Lir 000035	e Re	placer	nent	in H	lammerly	Area		SUI	RFAC	E ELE	EVAT		3.50
			H	Iouston, Texas-77054	PRO	JECT			3-164			r-3 RING T	YPE:	Au	ger			(%)		ERBE			
			1	LOCATION	(P,tsf)		20		blows/f		(JC	JMP.	(%) N		Natural	Moisture (	Content	• .				PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
	\ ,,	SC	>	Moorberry Ln.	ЕТЕВ(	of)		<b>A</b> (	$Q_u$ (tsf) 0 3.0	<b>A</b>	TY (pcf)	ED CC 1 (tsf)	TRAIN	; (psi)	Atte	and erberg Lim	nits	CONTENT	IMIT	CLIMIT	NI YTIC	200 SI	D ANGLI FRICTIC SSTS & F
DEPTH (ft.)				Northing: 13859278.53 Easting: 3064912.71	ET TROM	BLOW COUNT (N, Blows/Foot)	90	★ D. 0 10	D (pcf) 00 110	* ) 120	DRY DENSITY	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	Moisture Content	Liguid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	# SING	ESTIMATE INTERNAL OTHER TE
O DEF	5		MA	MATERIAL DESCRIPTION	POCK! PENET	BLON (N, Bk	<b>♦</b>	<i>\</i>	P (tsf) 0 3.0	•	DRY	UNC	FAIL	CON	20	⊖ 40 60	— — - <b>I</b> 	MOIS	7	PL	PI	PAS	EST INTE OTH
			ŀ	6" Concrete Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.5					<b>*</b>					φ			6					
				hard below 2'	4.5					•					<b>O I1</b>			9	33	16	17	61	
- 5 -					4.5					•								10					
	CI			with ferrous nodules below 6'	4.5					•					φ			12					
				very stiff below 8'	3.5			<b>A</b>		*	116	1.35		0	0			11					
- 10 <del>-</del> 				hard below 10'	4.5					•					Ф <b>н</b> —			11	36	17	19		
					4.5					•								13					
Water Water Dry Sampl	Obse	rvatior	ıs:	ntial: ♀ After Drilling▼ 24 Hrs: ▼ Initial Water Level: Dry, After Drilling Water Level:  PT	N P T Q	- SP - Poo - Tor - Und	vane (t	(Blows enetron osf) ed Com	neter (t np. Stre	sf) ngth (tsf)		gered			le Grouted hecked B						son a	and S	Sons ,

		1 ~ ~ .		tod Tostino I aboutonica Inc						L	.00	G OF	B	ORII	NG	B-	53	}	PAGE	1 OF 1	DA	TE			7/	/10/2013
	Α	ISSO	)cia E	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	P	ROJE	CT:	Pr	ropos	sed l	Wate	er Lin 0035	e Re	place	men	nt in	На	mmerly	/ Area		SUI	RFAC	E ELI	EVAT		7.59
			Ì	Houston, Texas-77054	P	ROJE	CTI		G13			0033		)-3 )RING	TYPE	: <i>/</i>	Aug	er			(%)		ERBI		(%)	
				LOCATION		P,tst)		20	N (			<b>•</b> 80	c)c	JMP.	(%) N	-	T	Natural	Moisture	Content	• .			_	EVE (9	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
·		US	EVEL	1 ,		ETER( NT	(to	1.0	<b>▲</b> (0 2.	Q <sub>u</sub> (tsf 0 3	f) <b>^</b> 3.0	4.0	TY (pcf)	ED CC	STRAII	(7.1	(bsi)		and erberg Lin	nits	CONTENT	LIMIT	C LIMIT	II YTIC	500 S	D ANGLI FRICTIC SSTS & F
DEPTH (ft.)	SAMPLES	031	O TERLI	Northing: 13859283.23 Easting: 3065385.84	ŒŢ	PENETHOMETER(P,tst BLOW COUNT	ws/Fo	90	<b>★</b> D	D (pc	cf) ★	7	DRY DENSITY	UNCONFINED COMP	FAILURE STRAIN (%)	CONFINING	SSUR	Plastic Limit	Moisture Content	Liquid Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE	ESTIMATE INTERNAL OTHER TE
O DEI			N N	MATERIAL DESCRIPTION			(N, Bk	<b>♦</b> 1.0		P (tsf) 03		<b>♦</b> 4.0	DRY	UNC	FAIL	SON	PRE	<u>20</u>		80 80		LL	PL	PI		EST INT! OT!
	$\left\  \cdot \right\ $	SC SM		Silty-Clayey Sand (SC-SM), compact, slight plasticity, light gray and tan	2.5	5											q	) <b>H</b>			5	19	14	5	45	
	$\int$			Sandy Lean Clay (CL), stiff, medium plasticity, light gray and tan	1.5	5			•									$\phi$			13					
 - 5 -	$\int$			with sand seam below 4'	2.0		-														16					
   	$\frac{1}{\sqrt{1}}$	CL		with sand pocket below 6'	2.0				•									0			17					
   	$\frac{1}{\sqrt{1}}$			firm below 8'	1.0			•										<b>-</b> 1			18	32	16	16		
- 10 - 	1				1.2	5		<b>A</b>	<b>•</b>		*		111	0.45	5	0	-	φ			14					
	$\bigvee$	SM		Silty Sand (SM), medium dense, non plastic, light gray and tan		1:	9	•	)									φ			15					ı
 - 15 -		CL		Sandy Lean Clay (CL), firm, slight plasticity, light gray and tan	1.0		-	•	•									•			17					
 	$\frac{1}{\sqrt{1}}$			Fat Clay with Sand (CH), very stiff, high plasticity, light gray and tan	4.0							<b>*</b>						<b>1</b>	-1-1		17	51	19	32	85	
 	1	СН			4.0				<b>A</b>		*	•	117	1.75	5	0					16					
Water Water Dry Samp	r Ol	bserv	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  SPT    Shelby Tube    Disturbed		P - I T - T Q,, - U	SPT Pock Torva Uncc	Data et Pe ane (p onfine	(Blow) enetror	netér np. Sti	` ′	h (tsf)		gered						rilling. Di ohn, QC/				son a	and S	Sons ,

		4				LOG OF	B	ORIN	IG E	3-5	PAGE 1 OF	= 1   1	DAT	Έ			6/	/20/2013
	F	Associai 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PROJE	ECT:	: Proposed Water Lin WBS No. S-000035	e Re	placer	nent	in H	lammerly Area	,	SUF	RFAC	E ELI	EVAT	ION	3. <i>37</i>
		I	Houston, Texas-77054	PROJE	ЕСТ	NO.: G13-164		)-3 )RING T	YPE:	Au	ıger		(%)		ERBE VITS(			
			LOCATION	,tsf)		● N (blows/ft) ●	6	MP.	(%)		Natural Moisture Conter	_		Liii	11110(	_	EVE (%	LE OF ION (°) REMA
		VEL	Knoboak Dr.	TER(F	a la	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	TY (pct	(tsf)	TRAIN	(bsi)	and Atterberg Limits		CONTENT	MIT	LIMIT	NI YTI	OO SIE	ANG FRICT
DEРТН (ft.)	SAMPLES	USC H	Northing: 13859026.5 Easting: 3064584.62	POCKET PENETROMETER(P,tsf) BLOW COUNT	vs/Foo	1.0 2.0 3.0 4.0 ★ DD (pcf) ★ 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	=			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEP	SAM	WAT	MATERIAL DESCRIPTION	POCKE PENET BLOW	N, Blo	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DRY I	UNCC	FAIL	CONF PRES	+		MOISTURE	2/7	PL	PI	PASS	ESTIMAT INTERNA OTHER T
- 0 `	1		Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	4.0		7.0 2.0 3.0 4.0					20 40 00 00		13	38	17	21	60	
	$\parallel$		process, ngm gray and tan								<b>Θ⊢−−</b>							
	$\parallel$		with sand seam below 2'	3.5									13					
	$\frac{1}{2}$										• • • • • • • • • • • • • • • • • • •							
	H			3.0									14					
- 5	$\frac{1}{2}$					•	-											
	Ц		stiff with ferrous nodules below 6'	2.0									14					
	$\left  \right $	CL		2.0		•												
	Ц																	
	$\rfloor / \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! $			2.0			114	0.7		0	<b>A</b>		15	33	16	17		
10	$\ $																	
- 10 -				2.0									12					
	$\parallel$										()							
				2.0									13					
	$\parallel$					<b></b>					ф							
	Н																	
Wate			ntial: ☑ After Drilling.▼ 24 Hrs: ▼	Key to A	Abbre	reviations:	Not											_
Wate Dry	r O	bservations!	Initial Water Level: Dry, After Drilling Water Level:	N P T -	SPT Poci Torv	T Data (Blows/Ft) cket Penetrometer (tsf) vane (psf)					le Grouted after Drilling. Checked By: Jitu/John, C					son a	and S	Sons ,
Samp	ole .	Key: 🛛 S	SPT 🛮 Shelby Tube 🖺 Disturbed	Q <sub>y</sub> - DD-	Unc Dry	vane (psf) confined Comp. Strength (tsf) Density (pcf)												

		١	. •	4. I Tankina I alianatanian I.			LOG OF	BC	RIN	G B-	55	PAGE	1 OF 1	DA	TE			6/	/20/2013
	Α	1 <i>SSO</i>	ciai E	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PRO	OJECT	T: Proposed Water Line WBS No. S-000035-	e Rep	olacen	nent in I	Наттеі	rly Area		SUI	RFAC	E ELI	EVAT		7.59
			1	Houston, Texas-77054	PRO	OJECT	T NO.: G13-164			YPE: A	uger			(%)		ERBI MITS(			ESTIMATED ANGLE OF INTERNAL FRICTION (?), OTHER TESTS & REMARKS
				LOCATION	(P,tsf)		● <i>N (blows/ft)</i> ● 20 40 60 80	ct)	ЭМР.	(%) N	Natura	al Moisture C	Content	CONTENT (		7	NDEX	PASSING #200 SIEVE (%)	3LE OF TION ( R REM/
·.		US	EVEL	Knoboak Dr.	POCKET PENETROMETER(P,tsf	ot)	<b>▲</b> () (tsf) <b>▲</b>	DRY DENSITY (pcf)	UNCONFINED COMP. STRENGTH (tsf)	FAILURE STRAIN CONFINING	A	and tterberg Lim			LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	£200 S	ED ANG FRIC
DEPTH (#.)	SAMPLES	000	TERL	Northing: 13859042.41 Easting: 3065270.37	(ET TROM	BLOW COUNT (N, Blows/Foot)	★ DD (pcf) ★ 90 100 110 120	DENS	ONFIN	FAILURE ST CONFINING PRESSURE	Plastic Limit	Moisture Content 	Liguid Limit	MOISTURE	LIQUID LIMIT	LASTI	LASTI	SING #	TMATE ERNAL IER TE
O DE	SAI		XX	MATERIAL DESCRIPTION		BLOV (N, Bl	◆ P (tsf) ◆ 1.0 2.0 3.0 4.0	DRY	UNC	FAII	20	40 60	 80		LL		PI	PAS	ES7 INT <sub>1</sub> OTF
-	$ \bigg/\bigg $			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.0		•				φ			14					
<u>-</u> -				with calcareous nodules below 2'	3.75						φ			13	30	16	14	52	
- - 5	_			with ferrous nodules below 4'	3.0		•				<b>-</b> •			15					
_ _	$\frac{1}{2}$	CL		stiff below 6'	2.0		•				0			18					
- -	1			with sand seam below 8'	1.5		•				•			19					
- 10 -	<del> </del>			very stiff below 10'	2.5		•				<b>1</b>			16	43	18	25		
-					4.0		<b>A *</b>	116	1.7	0	Φ			16					
Wate Wate Dry Sami	er Ob	bserva	ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  SPT    Shelby Tube    Disturbed	N P	- SP - Po	previations: PT Data (Blows/Ft) pocket Penetrometer (tsf) provane (psf) proonfined Comp. Strength (tsf) by Density (pcf)		gered t			ed after Dr By: Jitu/Jo					son a	and S	Sons ,

	/	l gga	iat	ad Tasting Laboratories Inc					LO	G	OF BC	ORIN	IG E	3-5	56 (	P	<b>Z-3</b> ) P	AGE	1 OF 1	DA	TE			6/	18/2013
	F	13300	3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PR	OJEC	CT:	Pro WE	pose SS N	ed W	/ater Lin	ne Re -018	placei )-3	me	ent in	Ha	ammerly Are	ea		SU	RFAC	E ELI	EVAT		7.14
			E	Iouston, Texas-77054				10.:					PRING 1	ΓΥΡ	PE: A	Aug	ger			(%)	1	ERBI MITS(	%)	(%	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
				LOCATION	(/P.tsf)			• 20	40	60	ft) • 0 80	l oct)	OMP.	( /0/ /4/	(%) N		Natural Moist an		Content	CONTENT		71	NDEX	IEVE (	GLE O TION ( & REM
ff.)	S	USC	LEVEL	Knoboak Dr. Northing: 13859126.21	METEF	UNT	(100)	1.0	2.0	(tsf) 3.0	0 4.0	SITY (µ	NED C rH (tsf)	7 1	STRA	łE (psi)	Atterberg Plastic Moisi	g Limi			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	#200 \$	ED AN IL FRIC TESTS
DEРТН (#.)	SAMPLES		ATER	Easting: 3065763.9	POCKET PENETROI	BLOW COUNT (N. Blows/Foot)	- Nows/r	90 •	100	) (pcf) ) 11 (tsf)	0 120 ◆	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	5	FAILURE STRAIN CONFINING	ESSUF	Limit Cont	ent	Liquid Limit — — - <b>I</b>	MOISTURE	LIQUIE	PLAST	PLAST	PASSING #200 SIEVE (%)	STIMAT TERNA THER T
10	Ś		3	MATERIAL DESCRIPTION	POC PEN	BLO (N. E	3,	1.0			0 4.0	DR	UN ST	Ĺ	E   S	PH	20 40	60	80	MC	LL	PL	PI	PA	O ≷ ES
-				6" Concrete Fat Clay with Sand (CH), stiff, high plasticity, light gray and tan	1.5				<b>•</b>								<b>17</b>	4		23	56	20	36	72	
_					1.75				<b>*</b>								þ			24					
- - 5	$\frac{1}{\sqrt{2}}$	СН		very stiff below 4'	2.5					•		_					<del></del>			17	50	19	31		
-				with ferrous nodules below 6'	2.75					•							•			18					
-				stiff below 8' ( slickensided )	2.0			•	*			98	0.6		0		<b>\</b>	-1		24	60	20	40		
- 10 -				Sandy Lean Clay (CL), stiff, high plasticity, light gray and tan with calcareous nodules	2.0				•								<b>#</b> 1			20	39	17	22	70	
-		CL		very stiff below 12'	3.0					•	*	114	1.07		9		•			17					
- 15					2.75					<b>*</b>							рч			19	30	16	14		
Dry, Leve	er Oi 24 h el: 14	bservat irs Wat	ions: er Le	ntial:   After Drilling  24 Hrs:  Initial Water Level: Dry, After Drilling Water Level: vel: Dry, 7 days Water Level: 14.5', 30 days Water  PT   Shelby Tube   Disturbed	N F T	- SF   - Pc   - To   - Ur	PT E ocke orva 'ncor	viations Data (E et Pene ane (ps nfined Density	Blows etrom af) Comp	etér (t o. Stre	tsf) ength (tsf)	/ / /	gered /25/201	13);	; PZ	wa	vater level: D ter level: 14' tu/John, QC/	(7/3	0/2013)	Drille					5' , Logged By:

				1.00 1.1 1						LO	G OF	BC	RIN	IG	<b>B-</b> 5	7	PAGE	1 OF 1	DA	TE			6/	20/2013
	A	ssoc	iai 3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PRO	OJECT	T:	Prop	osed	d Wa	ter Line 00035-	e Rep	olacer	nent	t in F	lamm	erly Area		SU	RFAC	E ELI	EVAT		1.94
			H	Iouston, Texas-77054	PRO	OJECT					00033-		RING T	YPE:	Αι	ıger			(%)		TERBI MITS(		(%)	= %, 4BKS
			$\prod$	LOCATION	(P,tsf)			• 1 20	N (blo 40	ws/ft) 60		ct)	ЭМР.	(%) N		Nati	ıral Moisture	Content	CONTENT (		7	NDEX	IEVE (9	GLE OF TION ( & REM,
ft.)		JSC	LEVEL	Knoboak Dr. Northing: 13859352.08	WETER	BLOW COUNT (N, Blows/Foot)		1.0	2.0	(tsf) 3.0	<b>▲</b> 4.0	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	VG RE (psi)	Plastic	and Atterberg Lir Moisture			LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
DEPTH (#.)			ATER	Easting: 3066485.08	<i>POCKET</i> PENETRO	W CO		<b>★</b> 90 <b>♦</b>	100 ( 100 P (1	(pcf) 110	* 120 •	Y DEN	CONF	NLURE	CONFINING PRESSURE	Limit	Content	Liquid Limit - — — -I	MOISTURE	LIQUIE	PLAST	PLAST	SSING	TERNZ TERNZ THER
0	)		S	MATERIAL DESCRIPTION	POC PEN	BLC (N, L				3.0	4.0	DA	N) TS	7	CC	20	40 60	80	M	LL	PL	PI	PA	Si ≷ Ci
	4	AA	8	7.5" Concrete						:														
-	$\backslash$			Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	3.5					•	<b>)</b>					φ			12					
				very stiff with calcareous nodules below 2'	4.0						•					 	-		10	30	16	14	59	
- 5 -				with ferrous nodules below 4'	3.0					<u>.</u>									12					
	1				<i>2.75</i>					•									20					
		CL			3.5						•	116	1.2		0				13					
- 10 <del>-</del> 					3.0					•						<b>ΦI</b> -	1		14	43	18	25		
				hard below 12'	4.5					<b>A</b>	*	122	2.68		9	0			13					
Dry	Obs	ervat	ons:	ntial:   After Drilling   After Drilling   After Drilling Water Level:   Dry, After Drilling Water Level:	N P	to Abb - SP - Po - Toi - Un	PT Dai ocket l	ta (Blo Peneti	romet	er (tsf	) gth (tsf)		gered i				uted after D d By: Jitu/J					son a	and S	Sons ,
Sampl	e Ke	ey:	oxtimes S	PT $\square$ Shelby Tube $\square$ Disturbed	D	ロ- Dry	y Den	isity (p	oct)			1												

		4		to I Tooking I also make also I a						L	OC	G OF	B	OF	RIN	G E	3-5	8		PAGE	1 OF 1	DAT	ΓΕ			6/	/20/2013
	P	4SSO	3	ed Testing Laboratories, Inc. 143 Yellowstone Blvd	PF	ROJEC	т: <i>Н</i>	Prop	pose	ed V	Vate	er Lin 10035	e Re	pla	cem	ent	in H	amme	erly	Area		SUF	RFAC	E ELI	EVAT		3.98
			H	Houston, Texas-77054	PF	ROJEC						0000			IG TY	/PE:	Au	ger				(%)		ERBI MITS(		(%	= °), 4RKS
				LOCATION		PENETHOMETEH(P.187) BLOW COUNT (N. Blows/Foot)		• 20	N (b 40	6	0	80	ict)	OMP.		(%) N		Natu	ıral N	loisture ( and	Content	CONTENT (		7	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
(2)		USC	EVEL	Canoga Ln. Northing: 13859102.27	ļ	IIE I ET JNT Sot)		1.0	2.0	u (tsf) 3.	0	4.0	א אדופ	VED C	H (tst)	STRAI	G E (psi)			berg Lim			LIMIT	C LIM	CITY I	#200 S	ED AN L FRIC ESTS
DEРТН (ft.)	SAMPLES		TER L	Easting: 3066906.62	KET	V COL Iows/Fc		90	DE 100	) 11			DRY DENSITY (pcf)	ONFI	STRENGTH (tsf)	FAILURE STRAIN	CONFINING PRESSURE (	Plastic Limit	(	Moisture Content	Liguid Limit — — -	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	LASTI	SING ;	ESTIMATED INTERNAL F OTHER TES
S DE	SA		W	MATERIAL DESCRIPTION	POCK	BLOV (N, B)		<b>♦</b> 1.0	P 2.0	(tsf) 3.	0	<b>♦</b> 4.0	DRY	NA A	STR	FAI	CO P.B.	20		0 60	80	MOI	LL	PL	PI	PAS	ES: INT OTI
- <i>0</i> -	1			5.5" Concrete Sandy Lean Clay (CL), very stiff, medium plasticity, light gray and tan	2.5					•								Θ				12					
	$\int$				3.5	;					•							φ <b>⊢</b> -				11	32	16	16	65	
- 5 -	$\frac{1}{\sqrt{1}}$			hard below 4'	4.5	;						•	_				-	-				14					
	$\frac{1}{\sqrt{1}}$	CL		with calcareous and ferrous nodules below 6'	4.5							•						<b>Q</b>				13					
	$\frac{1}{2}$	ŧ		very stiff below 8'	3.0	,					<b>&gt;</b>							<b>)</b>				20					
- 10 -	$\frac{1}{2}$				2.5	;				•							-	φ <b>⊢</b>		1		13	42	18	24		
 	1				3.5	;			<u>.</u>		*		114	1 1	.45		0					14					
Dry	r Ol	bserva	ations	ntial: 又 After Drilling 224 Hrs: ឬ : Initial Water Level: Dry, After Drilling Water Level:		to Abb N - SF P - Po T - To Q <sub>u</sub> - Un	T Dat cket F	ta (B Pene	Blows/ etrom	etér (	(tsf) engt	th (tsf)		ıger							rilling. Di hn, QC/				son a	and S	Sons ,
Samp	ole I	Kev:	$\boxtimes$ $s$	SPT 🛮 Shelby Tube 🗏 Disturbed		DD - Dr	y Den	sity (	(pcf)	J.//	J. Igu	(101)															

				A LOT AND THE STATE OF THE STAT			LOG OF	BC	PIN	IG B	-5	PAGE 1 OF 1	DA	TE			6/	20/2013
	F	Asso	ciai E	ted Testing Laboratories, Inc. 3143 Yellowstone Blvd	PR	OJEC		e Rej	olacen	nent i	n F	Hammerly Area	SUF	RFAC	E ELI	EVAT	ION	1.43
			1	Houston, Texas-77054	PR	OJEC	WBS No. S-000035 CT NO.: G13-164		1-3 RING T	YPE:	Αι	uger	(6)		ERBI MITS(			
				LOCATION	(Jst.		● N (blows/ft) ●	6	MP.	(%)		Natural Moisture Content	ENT (%)	LII	VII 1 O(	_	:VE (%	LE OF ION (°) REMA
			VEL	Knoboak Dr.	TER/F	<u> </u>	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	77 (pcr	:D COI	TRAIN	(bsi)	and Atterberg Limits	CONTENT	TIMI	LIMIT	ITY IN	OO SIE	ANG FRICT
DEРТН (ft.)	SAMPLES	US	C HE	Northing: 13859411.38 Easting: 3067213.24	<u>∃</u> T TROME	BLOW COUNT	(to 1.0 2.0 3.0 4.0 <b>*</b> DD (pcf) <b>*</b> 90 100 110 120	DRY DENSITY (pcf)	UNCONFINED COMP STRENGTH (tsf)	FAILURE STRAIN (%)	PRESSURE (	Plastic Moisture Liquid Limit Content Limit	MOISTURE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PASSING #200 SIEVE (%)	ESTIMATED ANGLE OF INTERNAL FRICTION (°), OTHER TESTS & REMARKS
, DEP	SAM		WAT	MATERIAL DESCRIPTION	POCKET PENETE	BLOW	©	DRY I	UNCC	FAIL	PRES		MOIS	)7    LL		PI PI	PASS	ESTI INTE OTHI
- 0	7		P 8	5.5" Concrete														
-	$\frac{1}{2}$			Sandy Lean Clay (CL), hard, medium plasticity, light gray and tan	4.5							φ	11					
-  -					4.5								9	37	17	20	70	
-	$\frac{1}{2}$			with ferrous nodules below 4'	4.5								12					
- 5	$\frac{1}{4}$						<b>•</b>											
-	-			with calcareous nodules below 6'	4.5		•						14					
_	$\frac{1}{2}$	CL			4.5			113	2.2		0		21					
- 10	$\frac{1}{2}$			very stiff with high plasticity below 10'	4.0			113	1.75		0	<b>Y</b>	14	38	17	21	61	
_							* *					φ						
-	-//				4.0		•						11					
- - 15	$\frac{1}{1}$				3.5			118	1.6		10		14					
- "	$\prod_{i=1}^{n}$																	
Dry	er O		ations	Intial:   After Drilling   24 Hrs:   Initial Water Level: Dry, After Drilling Water Level:  SPT    Shelby Tube    Disturbed	F	I - SI - Po - To D., - UI	bbreviations: 6PT Data (Blows/Ft) Pocket Penetrometer (tsf) Forvane (psf) Unconfined Comp. Strength (tsf) Ory Density (pcf)		gered t			ole Grouted after Drilling. Di Checked By: Jitu/John, QC/				son a	and S	Sons ,

## **KEY TO LOG TERMS AND SYMBOLS**

## **SOIL TYPE**

## **SAMPLER TYPE**













CLAY











**ROCK** 

**GRAVEL** 

**SHELBY** 

SAND

SILT

**PEAT** 

**SAMPLE** 

SAMPLE

TUBE

**SPOON** 

**MODIFIER** 

















STONE

**GRAVELY** 

SANDY

SILTY

**FILL** 

**RECOVERY** 

**ROCK CORE**  2" SHELBY **TUBE** 

CONE

**UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D 2487** 

М	AJOR D	IVISIONS	LETTER SYMBOL	TYPICAL DESCRIPTIONS
	GRAVEL &	CLEAN GRAVELS	GW	WELL GRADEED GRAVELS,GRAVELSAND MIXTURES WITH LITTLE OR NO FINES
COARSE GRAINED	SOILS LESS THAN 50%	LITTLE OR NO FINES	GP	POORLY GRADED GRAVELS, GRAVEL SAND MIXTURES WITH LITTLE OR NO FINES
SOILS LESS THAN 50%	PASSING No.4 SIEVE	W/ APPRECIATEBLE	GM	SILTY GRAVELS,GRAVEL SAND-SILT MIXTURES
PASSING No. 200		FINES	GC	CLAYEY GRAVELS,GRAVEL SAND-CLAY MIXTURES
SIEVE	SANDS	CLEAN SANDS LITTLE	SW	WELL GRADED SAND,GRAVELY SAND (LITTLE FINES)
	MORE THAN 50%	FINES	SP	POORLY GRADED SANDS,GRAVELY SAND(L. FINES)
	PASSING No.4 SIEVE	SANDS WITH APPREA.	SM	SILTY SANDS,SAND-SILT MIXTURES
	NO.4 SIEVE	FINES	SC	CLAYEY SANDS,SAND-CLAY MIXTURES
			ML	INORGANIC SILTS & VERY FINE SANDS,ROCK FLOUR SILTY OR CLAYEY FINE SANDS OR CLAYEY SILT W/PI
FINE GRAINED		D CLAYS LIQUID LIMIT LESS THAN 50	CL	INORGANIC CLAY OF LOW TO MEDIUM PI LEAN CLAY, GRAVELY CLAYS,SANDY CLAYS,SILTY CLAYS
SOILS LESS THAN 50%			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PI
PASSING NO. 200 SIEVE			MH	INORGANIC SILTS,MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
		D CLAYS LIQUID LIMIT EATER THAN 50	СН	INORGANIC CLAYS OF HIGH PLASTICITY FAT CLAYS
			ОН	ORGANIC CLAYS OF MED TO HIGH PI, ORGANIC SILT
	HIGHLY OR	GANIC SOIL	FT	PEAT AND OTHER HIGHLY ORGANIC SOILS
UNC	CLASSIFIED F	FILL MATERIALS	ARTIFICIALLY MATERIALS	DEPOSITED AND OTHER UNCLASSIFIED SOILS FILL

## **CONSISTENCY OF COHESIVE SOILS**

CONSISTENCY	UNCONFINED COMP.	
CONSISTENCY	STRENGTH IN TSF	
VERY SOFT	LESS THAN 0.25	
SOFT	0.25 TO 0.5	
FIRM	0.5 TO 1.0	
STIFF	1.0 TO 2.0	
VERY STIFF	2.0 TO 4.0	
HARD	GREATER THAN 4.0	

CONSISTENCY	UNCORR. POCKET	
CONSISTENCT	PENTROMETER READ.	
VERY SOFT	LESS THAN 0.25	
SOFT	0.25 TO 0.5	
FIRM	> 0.50 TO 1.50	
STIFF	> 1.50 TO 3.00	
VERY STIFF	> 3.0 TO 4.50	
HARD	4.5+	

## **RELATIVE DENSITY - GRANULAR SOILS**

CONSISTENCY	N-VALUE (BLOWS PER FT)		
VERY LOOSE	<4		
LOOSE	5-10		
MEDIUM DENSE	11-30		
DENSE	31-50		
VERY DENSE	>50 OR 50+		

# CLASSIFICATION OF GRANULAR SOILS

#### **U.S.STANDARD SIEVE SIZE(S)**

